THE REPERTORY OF PATENT INVENTIONS AND OTHER DISCOVERIES AND IMPROVEMENTS IN ARTS, MANUFACTURES, AND AGRICULTURE,

BEING A CONTINUATION, ON AN ENLARGED PLAN, OF THE

Repertory of Arts and Manufactures,

A WORK ORIGINALLY UNDERTAKEN IN THE YEAR 1794, AND STILL CARRIED ON, WITH A VIEW TO COLLECT, RECORD, AND BRING INTO PUBLIC NOTICE,

THE USEFUL INVENTIONS OF ALL NATIONS.

VOLUME I.

LONDON:

PUBLISHED FOR THE PROPRIETORS, BY T. AND G. UNDERWOOD, 32, FLEET-STREET.

1825.

C. Baldwin, Printer,
No. Bridge Street, London.

CONTENTS

OF

THE FIRST VOLUME.

Specifications of Patents.

Original Communications, Translations and Selections from other Works, Parliamentary Papers, &c.

Account of New Patents.

Account of French Patents.

Review of New Books.

APPENDIX.

AN ESSAY ON THE LAW OF PATENTS.

PLATES.

ADVERTISEMENT.

THE design of this Work having been often very imperfectly understood from its late title, *The Repertory of Arts*, which has been frequently represented as not sufficiently explanatory of the precise nature of the publication; and it having been also in many instances confounded with other periodical works which have, since its establishment, appeared under a similar appellation, the Proprietors determined to commence a New or Third Series, and to adopt the variation in the original title that the reader will perceive they have prefixed to the present Volume; and at the same time to enlarge the plan of the Publication, by the introduction of an abridged account of Patents recently obtained, with occasional remarks upon their respective merits, which they believe has been considered an improvement of the Work, and rendered it more interesting. In the preparation of this part of the Work the utmost care will at all times be taken faithfully and correctly to describe the invention; and in the remarks, to be guided by the strictest impartiality—fair and just criticism being the point at which the Editors will most scrupulously aim; and they trust the specimen which the present Volume exhibits will prove their honest intentions.

The Proprietors beg leave also to observe, that the new type they have adopted has enabled them to give nearly eight pages, or half a sheet, of additional matter in every Number; and that they have farther increased each Number of the present Volume to the extent of another sheet, or sixteen pages; and they are gratified that the exertions and expense they have incurred to render the Work more deserving of the patronage of the Public, has been recompensed by an increased circulation.

With the view of rendering the Work still further useful to Inventors, the Proprietors have been induced to print, by way of Appendix, a concise Essay on the Law of Patents, a Work of which the Author, from his continued intercourse with Patentees for many years, as an Agent for obtaining Patents, has felt to be much wanted.

THE

REPERTORY

OF

PATENT INVENTIONS, &c.

No. I. JULY, 1825.

Specification of the Patent granted to FREDERIC LEWIS FATTON, *of New Bond-street, in the county of Middlesex, watchmaker, for an astronomical instrument or watch, by which the time of the day, the progress of the celestial bodies, as well as carriages, horses, or other animals, may be correctly ascertained. Partly communicated to him by a foreigner residing abroad.* Dated Feb. 9, 1822.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. *Now know ye*, that in compliance with the said proviso, I, the said Frederick Lewis Fatton, do hereby declare the nature of the said invention of an astronomical instrument or watch, by which the time of the day, the progress of celestial bodies, as well as carriages, horses, or other animals, may be correctly ascertained, as is particularly described and ascertained in and by the annexed sheet of drawings or plans, and in the following description thereof, that is to say:

Fig. 1 (see Plate I.) on the annexed sheet of drawings represents the instrument as it would appear with the dial plate taken off, in order to explain the construction of the mechanism which lies beneath it.

Fig 2 shows an elevation or section of part of the instrument, supposing the ordinary spring barrel, fusee, escapement, and other parts of the time-keeper or watch, to be removed, as they do not constitute any part of the said invention.

Fig. 3 represents a plan of the instrument, with the hands and dial plate in their proper situations; the same letters of reference are used to denote corresponding parts in all the figures: A, fig. 1, shows the cock to support the upper part of the escapement wheel, the place of which wheel is represented by the dotted circle, *a, a*; but the escapement itself, as well as the spring barrel, fusee, and other parts constituting the ordinary movements of time-keepers or watches, may be employed; and being so well understood, I shall not enter into any particular description of them. A small pinion is fixed upon the upper end of the arbor or axis of the escapement wheel, which pinion engages in the teeth of a wheel, S, the arbor or axis of which wheel passes through a cock, or support, *c*, and carries a revolving dial plate, D, upon its upper extremity, as seen in figs. 2 and 3, and also by the dotted circle, *d d*, in fig. 1; the revolving dial plate and wheel, S, make a complete revolution in one minute, and has 60 divisions marked upon its surface, as seen at D in fig. 3, to indicate seconds of time, being numbered at every five seconds; the wheel, S, has a pinion, *c*, of 6 teeth fixed to it, engaging in the teeth of a wheel, E, of 72 teeth, situated beneath the plate, X, X, as seen in fig. 2; the upper part of the arbor or axis of the wheel, E, is furnished with a wheel, F, of 60 teeth, which engages with the teeth of the small wheel, G, of 30 teeth, having upon its axis or arbor a pinion of two leaves or teeth, engaging in the teeth of the wheel, H, of 120 teeth, the axis of which carries the hour hand of the instrument, and makes one complete revolution in 5 hours, the dial being numbered at every hour, as seen at *h*, in fig. 3; the teeth of the small wheel, G, engage into the teeth of the wheel, M, of 60 teeth, seen in figs. 1 and

B, the arbor or axis of which carries the minute hand, and makes one complete revolution in 10 minutes; the dial is numbered at every minute, as seen at *m*, in fig. 3; the arbor or axis of the wheel M has a snail or spiral plate, O, fixed upon it, the object of which will be hereinafter explained: P, fig. 1 and 2, represents a flat plate of metal, which moves upon an axis or arbor at *e*, the upper pivot of which is supported in the fixed cock, I, and the lower pivot turns in the plate, X, X, fig. 2; the plate P has a projection or beak, *p*, formed on one side thereof, the extremity of which beak bears against the circumference of the snail or spiral plate, O, and is always kept into close contact by the force of the spring, K, which acts upon the plate, P, near to the axis, *e*, as seen in fig. 1: N shews a small standard, screwed fast upon the plate, P; it is divided into a fork at the top, and furnished with two centre screws to support the pivots of a short axis, *r*, having a lever or arm, T, projecting from it on one side, and a short beak or detent, *t*, on the opposite side of the said axis. The detent, *t*, is borne upwards by a spring, *s*, which spring operates to depress the extreme end of the lever, T, which extends or reaches some distance over the surface of the revolving dial plate, D. The axis, *r*, has also a small detent or arm, *w*, projecting downwards, or nearly at right angles with the lever, T, as seen in fig. 2. The lower extremity of the detent, *w*, is acted upon by the points of the notched or star wheel, *x*, which is fitted so as to turn freely round upon a small screw fixed in the plate, P, and is caused to remain at rest with its points always in one certain position, by means of the slight spring, *k*, screwed fast to the plate, P, having a double inclined plane or wedge-piece formed at its extremity, which falls in between two of the points of the star wheel, and thereby determines its position. The star wheel, *x*, is moved round a space of one tooth at a time by the bent lever, *v*, which turns upon a screw, *n*, fixed in the plate, P; the end, *v*, of the said lever is guided and kept down upon

the plate, P, by passing under the head of a screw, *o*; and the opposite end near to the centre screw, *n*, is bent in a reverse direction, and has a projecting piece, *q*, formed to an arc of a circle, described round the centre or axis, *e*, of the plate, P; the piece, *q*, is acted upon by the small pin or button, *z*, which projects through the external case of the instrument, so as to be capable of being pressed upon by the finger in using the instrument. The bent lever, *v*, is limited in its motion by having a groove formed in the part *q*, which groove slides round the axis, *e*, and comes to bear firmly upon the said axis; when the button, *z*, is forced in sufficiently, the bent lever, *v*, is caused to return to its original position, when the button, *z*, is left at liberty, as seen in fig. 1, by the force of a small spring, *y*, which is screwed fast upon a projecting part of the plate, P, and bears against the bent lever, *v*, nearly opposite to the place where the button, *z*, acts; the lever or arm, T, is furnished with a small screw, 1, at its extremity, as seen in fig. 2, which screw passes through the end of a slight steel spring, 2, having a nib or beak formed in it similar to a pen, for the purpose of containing a small quantity of ink or colour, as will be hereinafter explained. The slight spring, 2, is made square at one end, and is screwed fast to the arm, T, near to the axis, *r*; 3 shows a screw passing through the arm, T, the point of which rests upon the end of a spring, 4, fixed to the plate, P, as seen in fig. 1. The action of the above described mechanism is as follows: when the button, *z*, is pressed so as to bear against the arched part, *q*, of the bent lever, *v*, it move the said lever round its centre screw or axis, *n*, and causes the end of the lever, *v*, to press against one of the points of the star wheel, *x*, and move the said star wheel round upon the centre screw at the same time that one of the points of the star wheel is in contact with the extremity of the detent, *w*, and by the motion of the said star wheel forces the detent, *w*, to move round its axis, *r*, and thereby raises the end, 1, of the lever, T, up from the surface of the

revolving dial, at the same time depressing the spring, *s*, until the point of the star wheel has advanced sufficiently to quit the end of the detent, *w*, at which instant the spring, *s*, re-acts against the beak, *t*, and throws the end, 1, of the lever, T, suddenly down, so as to cause the nib of the spring, 2, to touch or strike the surface of the revolving dial, D, by its momentum overcoming the force of the spring, 4, which the screw, 3, bears upon, as hereinbefore described; the inclined part of the spring, *k*, falls between two of the points of the star wheel, and places it in a proper position to repeat the action; the bent lever, *v*, is returned to its original situation by the spring, *y*, before mentioned; the end, *v*, of the bent lever, is furnished with a spring piece, as shown at 6, in fig. 1, which yields sufficiently to allow the lever to return freely by the points of the star wheel. The action of the above described mechanism is so sudden, that a person may cause the nib of the spring, 2, to strike the revolving dial, D, five or six distinct blows in each second of time, if required, for a rapid succession of observations. The manner of preparing the instrument for an observation is as follows: the main spring of the instrument should be wound up by its key into a state ready to act, having its motion suspended by means of the small stop, 8, projecting through the side of the case, as in ordinary stop watches; after which, the arm, T, should be raised up some distance from the surface of the revolving dial plate, D, by pressing the finger upon the small pin, 5, fig. 2, in which situation a minute quantity of colour (prepared by grinding tripoli, or other coloured substance, with olive oil) is to be introduced by means of a camel hair pencil or otherwise, into the nib of the spring, 2, before-mentioned. When this is done, the lever, T, is left at liberty, and the point of the screw, 3, comes to bear upon the end of the spring, 4, which prevents the nib of the spring, 2, from touching the surface of the revolving dial plate; the minute hand, *m*, should be placed at the number 10, and the revolving dial plate, D, turned round,

until the number 60 be brought opposite to the arm, T, as seen in fig. 3, in which situation the nib of the spring, 2, containing the colour as before mentioned, will be near the outer circumference of the revolving dial plate, D. Now suppose, for example, I wish to ascertain and register, by this instrument, the precise moment of one body or object passing by another, I first observe the time of day by any good watch or time-keeper, and by means of the stop 8, set the instrument in motion at a known or determined time, holding the instrument in the hand, with the end of the fore finger bearing lightly upon the button, z, seen in figs. 1 and 3; whilst the instrument is in motion, the divisions upon the face of the revolving dial plate, D, pass regularly under the nib of the spring, 2, but without touching the same, and the minute hand, *m*, advances one division during an entire revolution of the dial, D; when the instant arrives which I wish to note or ascertain, I press the button, z, with a sudden motion of the fore finger, which causes the lever or arm, T, to rise and fall again almost instantaneously, by the operation of the star wheel, bent lever, &c. as hereinbefore described; this action causes the nib of the spring, 2, to strike slightly upon the surface of the revolving dial, and leave a permanent mark or dot; the nib of the spring, 2, does not remain in contact with the surface of the dial any sensible time, but is thrown up again almost instantaneously, by the action of the spring, 4, bearing against the point of the screw, 3, as before mentioned, the nib being caused to touch the dial by the momentum of the lever, T, overcoming the resistance of the spring, 4, in a slight degree, that being sufficient to leave a visible mark or dot of colour upon the revolving dial, D, by alternately pressing and relieving the button, z; in this manner, a succession of marks or dots may be made upon the dial, D, without looking at it, if required for a number of observations, occurring suddenly after each other, and read off at leisure from the dial. The instrument above described is capable of marking dis-

tinctly upon the revolving dial plate D; a series of observations during 10 minutes of time, without interruption, or danger of any one mark or dot interfering with another. I have already mentioned that the nib of the spring, 2, is near the outer circumference of the revolving dial plate, D, when the instrument is first set in motion to commence the observations. I have also stated that the spring, 2, with the star wheel and other mechanism, which causes the nib of the said spring to mark upon the dial plate when required, was mounted upon a plate of metal, P, capable of moving round a centre of motion, *e*, in the annexed drawing, and it remains for me to explain how the requisite motion is communicated to the plate, P. When the minute hand, *m*, points to the number 10, as in fig. 3, the projecting beak, *p*, of the plate, P, is acting against the smallest diameter of the snail or spiral, O; which allows the nib of the spring, 2, to recede from the centre of the revolving dial plate, D, near to the circumference thereof; and as the minute hand turns round along with the snail or spiral, O, once in ten minutes, the motion of the snail causes the nib of the spring, 2, to approach the centre of the revolving dial, D, gradually, so that the succession of dots or marks which may be made upon the revolving dial plate will be arranged in a spiral direction, commencing at the circumference, and approaching the centre, forming ten complete evolutions, each evolution indicating a minute of time, and the place where the dots or marks happen to fall upon the radial line, drawn upon the dial, as seen in fig. 3, indicate the seconds of time; as soon as the minute hand, *m*, has completed its revolution, the beak, *p*, of the plate, P, will drop suddenly towards the centre of the snail, O, by the action of its spring, *k*, before mentioned, and remove the nib of the spring, 2, to the outer circumference of the revolving dial, from where it first started; when it is required to commence a new series of observations with this instrument, the dots or marks previously made must be cleaned off the surface of

the revolving dial, D; by means of a piece of linen cloth; the dial itself is made so as to be easily removed for that purpose. The radial lines, indicating seconds upon the revolving dial, are not drawn in straight lines, pointing to the centre, but are described by arcs of a circle, the radius of which is determined by the distance between the nib of the spring, 2, and the arbor or axis, *e*, of the plate, P. The instrument above described requires to be wound up every five hours, so that it is not adapted to be used as a watch or time-keeper, but might, if required, be made to serve both purposes, by having the hour circle, *h*, divided and numbered with the twelve hours, and the hour wheel work so arranged, that the hour hand, *h*, would make one complete revolution during 72 revolutions of the minute hand, *m*.

In some cases I do not employ colour to mark upon the revolving dial, as before described, but I make the nib of the spring, 2, with a fine point of steel, like a needle, and I make the revolving dial plate of tinned plate, or other soft metal, in such manner that it can be easily taken on and off the arbor of the seconds' motion. In this form of the instrument, a number of dial plates are provided, and the nib or point of the spring, 2, makes a distinct dot or puncture on the surface of the soft metal when required, which obliges a new dial plate to be used for every series of observations, and admits of preserving the marked ones undestroyed. Fig. 4 upon the sheet of drawing represents another form of the instrument, being adapted to a common watch; *h* represents the circle for the hours and minutes; and D, the revolving dial plate, which is fitted upon the arbor of the ordinary seconds' hand, so as to make a complete revolution in one minute, and is numbered at every 10 seconds: T shows the small lever, carrying the nib to contain colour, and mark upon the face of the revolving dial, D, to produce the dots or marks. The motion to produce the dots or marks is effected by the button, *z*, exactly in the same manner as described

Fig 8.

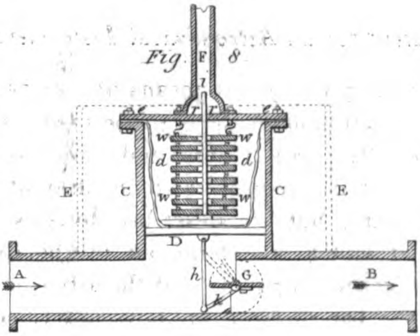
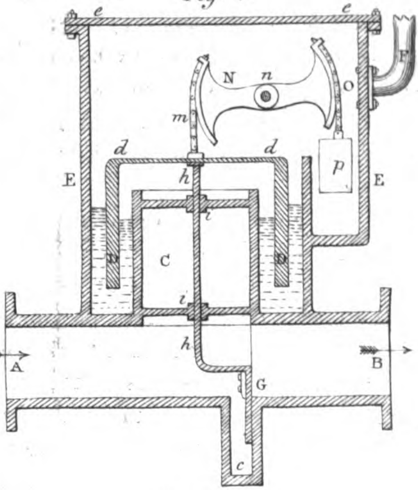


Fig 7.



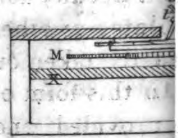


Fig 15.

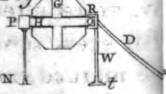
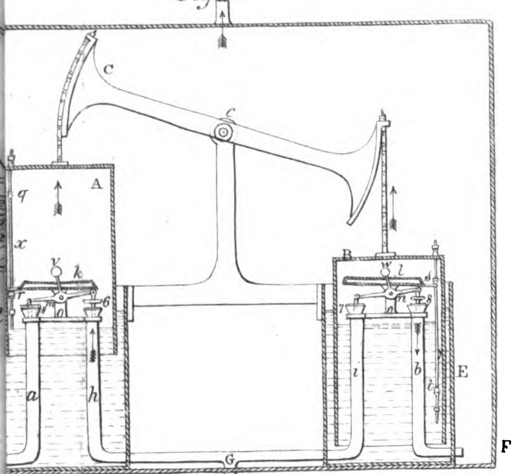


Fig 10.



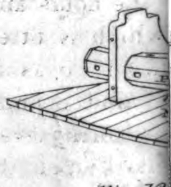


Fig. 12.

for the former figures; but the movement which is therein described, which causes the nib of the lever, T, to approach or recede from the centre of the dial, D, is not used at all in this figure, it being intended only to dot or mark during one revolution of the dial, D, before cleaning them off; consequently, the lever, T, with its star wheel, &c. are mounted upon a fixed plate instead of a moveable one, as described in the former figure: 8 shows a small button, which serves to stop the motion of the watch when required.

Figs. 5 and 6 represent part of the instrument, upon a different construction: the figs. 5 and 6 are drawn to the same scale as the figs. 1, 2, and 3. In this construction the dial plate is fixed, and the dots or marks are made upon it when it is required to ascertain any precise moment, by means of the seconds' hand revolving, and carrying a nib at its extremity, furnished with colour: P shows a plate of metal upon which the mechanism is placed, as in the former figures, except that it has no motion round a centre, as described at *e*, in figs. 1, 2, and 3, but is stationary: N shows a small standard, screwed fast upon the plate, P, which serves to carry the axis, *r*, of the lever or arm, T, with its short detent, *t*, and perpendicular arm or detent, *w*, against which the point of the star wheel acts as hereinbefore described; for the movement in figs. 1, 2, and 3, *s*, shows a small spring, which bears up the short detent, *t*, and depresses the lever or arm, T, till it rests upon a fixed stop in the standard, N: the end of the lever or arm, T, is formed like a small circular plate, having a hole through its centre, as seen at T, fig. 6, of sufficient size to admit the axis or arbor, S, of the seconds' hand, 2, to pass through without touching it; the upper part of the arbor, S, where it rises above the surface of the fixed dial plate, W, is formed to a joint, upon which the seconds' hand, 2, has liberty to vibrate when it is required to make the nib, 2, touch the dial plate, W, in order to leave a mark or dot of colour thereupon,

as before described. The arbor, s, has two small springs projecting from it, one on each side; the one marked 4 serves to bear up the nib, 2, and prevent it marking upon the surface of the dial, except when required; the other spring, 5, operates to make the nib, 2, strike suddenly upon the dial, and leave a mark or dot, in the same manner as the spring, *s*, described in figs. 1, 2, and 3; the seconds' hand, 2, has a small pin, 3, fixed in it, which pin projects downwards, and reaches near to the surface of the small round plate, formed at the end of the lever, T, as before mentioned; the star wheel, bent lever, &c. are the same as described in the other figures. The operation of the figs. 5 and 6 is as follows: suppose the seconds' hand to be in motion, and it is required to mark or note any precise moment, the button, *z*, before described in figs. 1, 2, 3, and 4, is pressed so as to move the star wheel, which, by the detent, *w*, raises the arm, T, and brings the surface of the small round plate up to the pin, 3, and raises the nib, 2, of the seconds' hand some distance from the dial plate, w, depressing the spring, *s*, until the point of the star wheel quits the end of the detent, *w*, at which instant the spring, 5, re-acts, and strikes the nib, 2, down upon the face of the dial plate, so as to leave a mark or dot of colour thereupon; the small plate at the end of the lever, T, would act equally upon the pin, 3, in every position of the seconds' hand. This construction of the instrument is only adapted to mark during 1 minute, without cleaning the dial plate from the previous dots or marks, in the manner before mentioned.

Having described the construction of the instrument in such manner as to enable persons conversant with such matters to put it in practice, it remains for me to state what I consider as constituting my claim, for I hereby declare that I do not claim the separate use of springs, star wheels, levers, or any other parts therein described or mentioned, but only as combined and applied in such manner as to form a new astronomical instrument or watch, which

possesses the property of ascertaining and recording the precise moment of any desired observation or series of observations, by means of marks or dots imprinted upon a dial or plate, whether the same be effected by the dial or plate revolving, and the marking point remaining stationary, or by the marking point revolving, and the dial or plate remaining stationary; the spring barrel, wheel work, and escapement for the instrument, may be made in any way that may be thought adviseable. As I do not make claim to any of the watch or time-keeper movements, the form and proportion of the parts may be also varied, according to the discretion of the workman.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM PONTIFEX, *the younger, of Shoe-lane, London, coppersmith and engineer, for new and improved modes of adjusting or equalizing the pressure of fluids or liquids in pipes or tubes; and also an improved mode of measuring the said fluids or liquids.* Dated July 1, 1824.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. *Now know ye*, that in compliance with the said proviso, I, the said William Pontifex, the younger, do hereby declare that the nature of my said invention doth consist, first, in an improvement on an apparatus now in use for adjusting and equalizing the pressure of fluids, when flowing through pipes or tubes. This said improvement is of a self-acting nature, and is particularly adapted to effect the operation of adjusting or equalizing the pressure of inflammable gas, in flowing through pipes or tubes, for the purposes of illumination, since it would tend to maintain an equality in the pressure or velocity of the gas, when issuing from the jets or burners, so as thereby to maintain the flame of

light proceeding from such burners at one uniform height, or nearly so, although the pressure of the gas in the conduct pipes or mains, which proceed from the gasometer or reservoir of supply, might vary considerably in its pressure from time to time. The apparatus may be supposed to be situated under ground, in any required part of the main, for which purpose its operative parts are entirely enclosed within a box or case, cast or otherwise, attached to the main; and in order to admit of a free action of the apparatus, the interior of the said box or case has a direct communication with the atmosphere through a pipe or tube, which proceeds to the surface of the ground; or the communication with the atmosphere may be formed in any convenient manner, according to the nature of the situation where the apparatus is employed. Secondly, in an improved apparatus for equalizing also the pressure of fluids in pipes or tubes, and which is particularly adapted to the operation of adjusting or equalizing the discharge of water, or other fluids or liquids, through a pipe or tube, although the pressure of water in the main or pipe of supply might vary occasionally in a considerable degree; and in which said improved apparatus a number of weights are applied, in such manner as to accumulate according to the resistance required. And thirdly and lastly, in an improved apparatus for measuring fluids, which apparatus performs the operation of measuring and registering the quantity of such fluids as may be caused to pass or flow through any pipe or tube, properly adjusted to the said apparatus, as hereinbefore more particularly described, by means of small gasometers, which are caused by an arrangement of valves and pipes, to move up and down alternately, in proportion to the quantity of fluid which passes through the apparatus. And in further compliance with the said proviso, I, the said William Pontifex, the younger, do hereby describe the manner in which my three several improvements may be performed, by the following description thereof, reference

being had to the drawing annexed, and the figures marked thereon, that is to say :—

DESCRIPTION OF THE DRAWING. (See Plate I.)

And first, with reference to my said improvement on an apparatus now in use, for adjusting and equalizing the pressure of fluids when flowing through pipes or tubes : in figure 7, A represents a portion of pipe which is supposed to be united to the main, which proceeds from the gasometer or reservoir of supply aforesaid ; and B shows a continuation of the said pipe or main, proceeding to the burners or part where the combustion is supposed to be going on ; the middle of the pipe, A B, has a cylindrical projection or short branch, C, rising perpendicularly from it ; the upper edge or superior aperture of the branch, C, is covered by an inverted vessel, D *d*, and the lower edge or mouth, D D, of this vessel, is immersed in water, tar, or other suitable fluid, contained in a box or case, E E, which is cast upon or otherwise secured to the pipe, A B This box has a lid or cover, *e e*, secured upon a flange at its upper part, so as entirely to enclose the inverted vessel, D *d* : F represents a pipe or tube, which communicates with the interior of the box, E E, and is supposed to proceed to the surface of the ground or otherwise, so as to afford a free access of atmospheric air to the interior of the box, E E, and consequently to the upper surface, *d d*, of the inverted vessel aforesaid. The inverted vessel is steadily guided by a projecting rod, *h h*, which slides through holes in stationary cross bars, *i i*, so as to admit of rising and falling in a perpendicular direction, with as little resistance as possible ; the lower end of the rod, *h h*, is bent sideway, and is affixed to a sliding sluice or valve, G, which is adapted to rise and fall along with the inverted vessel, D *d*, and by such motion to increase or diminish the aperture or passage of the pipe A B. This sluice, when fully open, descends into and is contained in the cavity, C, which is formed for the purpose in the bottom of the pipe, A B ; the upper surface, *dd*, of the inverted

vessel, is provided in the centre thereof with a chain, *m*, which is connected with an arched beam or lever, N; this lever moves upon a fixed centre or fulcrum at *n*, and is provided with a weight, *p*, suspended from a chain at its arched extremity, O. The object of the weight, *p*, is for the purpose of balancing in part the weight of the inverted vessel, D *d*, and causing it to remain just suspended, and in equilibrium. When the gas is at the regular required pressure in the pipe, A, the operation of the apparatus is as follows:—Suppose the gas to be flowing through the pipe or main from the gasometer, in the direction shown by the arrow, A, it will pass by the sluice, G, and proceed to the burners through the pipe, B, as shown by the arrow, B; but if the pressure of gas in the main at A should by any means be increased, the gas, by its elastic force, would operate upon the inverted vessel, D *d*, to raise the said vessel, in a certain degree, out of the fluid in which its mouth is immersed, and will thereby draw the sluice, G, (which is affixed to it as aforesaid) and diminish the area of the aperture through which the gas is obliged to pass in its way to the burners; thus, instead of the flames or lights being caused to burn higher by an increased pressure of gas, occurring in the mains or pipes of supply, they would be caused to maintain an equal height under such changes, in like manner; if a greater number of jets or lights should be turned on, they would, by requiring a greater supply of gas, tend to diminish the pressure in the mains or pipes of supply, so that the inverted vessel, D *d*, would descend in the fluid aforesaid by its own gravity, and would thereby lower the sluice, G, and open a passage of greater area for the gas to flow through, in order to meet the increased demand. This apparatus is adapted for very considerable variation of pressure, since the inverted vessel, D *d*, by being raised more out of the fluid in which it is immersed as aforesaid, will operate as an increasing weight, by displacing a less quantity of the said fluid; and as the counter weight, *p*, at the extremity, O, of the beam, N, is acting constantly with the same uniform

weight, as a counterpoise to the inverted vessel, the same will be perfectly at liberty to rise and fall with very minute variations of pressure, which may happen to occur in the pipes or mains. And secondly, with reference to my said second improvement, being an improved apparatus for adjusting and equalizing the pressure of fluids in pipes or tubes as aforesaid, and hereinbefore described to be particularly adapted to the operation of adjusting or equalizing the discharge of water. Fig. 8, upon the drawing annexed, represents a section of my said second improvement: A represents the pipe, supposed to be proceeding from the pipe of supply or main; and B represents a continuation of the same pipe, which is supposed to proceed to the service or part where the water is to be discharged. This pipe is furnished, near the middle of its length, with a turning valve, G, and the upper part, A, of the pipe, A B, opens into a cylindrical box or vessel, C, which contains a bag or sack, *d d*, formed of leather or other sufficiently pliable material, which will prevent the escape of the fluid through its substance; the lower part or bottom of the said sack is attached to a moveable board or plate, D, which is capable of rising and falling freely in the vessel, C; the uppermost edge of the sack, *d d*, is secured by being screwed firmly between the top flange and cover, *e e*, of the vessel, C, so as effectually to prevent the escape of the water or fluid at that part, although the plate, D, is at liberty to rise and fall without obstruction, being guided and steadied in its motion by a small rod, *i*, sliding through a hole in the centre of the cover, *e e*. Over the top of this rod a pipe, F, is screwed, having a free communication with the atmosphere, and communicating with the interior of the sack, *d d*, by holes or apertures, *r r*, formed through the lid, *e e*, as will appear evident upon inspection of the fig. 8, upon the drawing. The turning valve, G, has an arm or lever, *k*, projecting from it, which is jointed to the lower extremity of a small connecting rod, *h h*, the uppermost end of which is jointed to the underside of the

plate, D. By this arrangement, when the pressure of the fluid increases in the main and pipe of supply, A, from any cause, the plate, D, by such increase of pressure, will be caused to rise, and by its connecting rod, *h*, will tend to move the turning valve into the position shown by the dotted line in the figure, so as to diminish the aperture through which the water will be obliged to flow, in order to be discharged from the end, B, of the pipe; but as soon as the plate, D, has risen a short space, its upper surface will come into contact with the lowest of the suspended weights, *w*, which, by resting upon it, will operate to prevent it from rising higher, until still further increase of pressure occurs, when the plate, D, will continue to rise, and close the passage of the valve, G, until it meets with the second suspended weight, and so on throughout its whole range of motion, the suspended weight, *w*, producing the effect of an increasing resistance to oppose the rising of the plate, D, and thereby adapting the area or aperture of the turning valve, G, to the different degrees or variations of pressure, so as to maintain a sufficiently uniform discharge of water or fluid from the end, B, of the pipe, A B. The vessel, C, might be surrounded by an exterior vessel, as shown by the dotted lines, E E, and the vacant space, if desired, might be filled with any proper materials, to prevent the effect of frost upon the leather sack, *d d*. And, thirdly and lastly, with reference to my said third improvement, being an apparatus for measuring fluids or liquids by means of gasometers, having a reciprocating motion, as hereinbefore and hereinafter described. Figs. 9 and 10, upon the annexed drawing, will serve to explain a construction of the apparatus which is particularly adapted to the measuring of inflammable gas, for the purpose of illuminating. It consists of two inverted vessels or small gasometers, A and B, of a cylindrical or other convenient form, which are suspended by chains from the opposite extremities of a beam or lever, C, moving upon a centre or fulcrum, at *c*, in such a manner that

the vessels, A and B, may be caused to reciprocate or move up and down simultaneously, but in opposite directions; the lower edges or mouths of the vessels, A and B, are immersed in water or other suitable fluid, contained in the vessels D and E. The whole apparatus is enclosed in an air-tight box or exterior case, F F, having an exit pipe or tube, H, proceeding from it, to the part where the gas is supposed to be burned or consumed. The gas, which is suffered to enter into this case from the main gasometer or reservoir, through the service pipe, G, by the particular arrangement of the apparatus, as will be hereafter described, must necessarily pass through one or other of the small gasometers, A or B, and in such manner as the said gasometers will, by the pressure of the gas, be caused to move up and down alternately, through a determined space or range. Thus, if the cubical content or capacity of the small gasometers, A and B, and the extent of their range or motion, is previously ascertained, it will only be requisite to know how many times the beam, C, has reciprocated, in order to ascertain or measure the quantity of gas which has actually flowed through the apparatus from the service pipe, G, to the exit pipe, H, aforesaid. The number of reciprocâtions which may have been performed by the gasometers, A and B, and beam or lever, C, is intended to be registered by a train of wheel-work, or other such contrivance as is usually employed for such purposes; and being sufficiently understood, it will not be necessary to give a description of it in my specification. The mechanism for effecting the register may, if desired, be wholly situated within the case, F F, having a glazed aperture in some convenient part, for the purpose of observing the dials or indexes of the said register. This glazed aperture I should propose to form in a circular ring of metal, adapted to screw into a socket fixed into the case, F F, opposite to the dials or indexes aforesaid, in order that access may be obtained to the apparatus in case of derangement. I will now describe the

manner in which the gas is caused to enter and escape from the gasometers, A and B, at the proper intervals, to produce the desired effect. The service pipe, G, is formed withinside the case, F F, to a double branch, which enters the sides of the vessels, D and E, and turns up beneath the gasometers, A and B, as shown at *h* and *i* in the figures; the upper extremities of the pipes, *h* and *i*, rise some distance above the surface of the fluid contained in the vessels, D and E, and are furnished with valves, marked 6 and 7 in the figure: *a* and *b* represent two other pipes, the upper extremities of which rise above the surface of the fluid in the vessels, D and E, and are provided with valves, marked 5 and 8, similar to those last mentioned. The pipes, *a*, *b*, proceed to the bottom of the vessels, D and E, where they turn sideways, and open directly into the box or case, F F; the valves aforesaid are connected together in pairs, by small levers or beams, *m* and *n*, in the following order, viz. the valves 5 and 6 forming one pair, and the valves 7 and 8 forming another pair, the levers and beams, *m* and *n*, being adapted to move or vibrate upon centres or fulcrums in the middle of their length, which centres are supported upon brackets or standards, *o*, affixed to the upper extremity of the pipes, *h* and *i*. By this arrangement the corresponding valves, 5 and 7, and those 6 and 8, are caused to open and shut with a simultaneous movement; the said valves are caused to move at the proper intervals by the operation of small studs or projections, *q*, *r*, *s*, and *t*, which are formed on the sides of the rods or wires, *x* and *y*, attached to the upper part of the gasometers, A and B. These studs, *q* and *r*, *s* and *t*, do not operate directly upon the valves, but they are caused to operate upon small balance levers, *k* and *l*, which are made hollow, in the form of trunks, and contain a portion of mercury or other ponderous fluid, the object of which will be hereinafter explained. These balance levers are adapted to vibrate freely upon the same centres of motion as the levers, *m* and *n*, but with the liberty of

moving through a certain space, independently of the levers, *m* or *n*. The operation of the apparatus is as follows: Suppose the gasometers, A and B, to be in the position represented by the figure 10, the gas is supposed to be escaping from the exterior case, F F, to the burners, through the pipe, H; the valve, 6, being open, the gas will flow through the service pipe, G, and branch, *h*, into the gasometer, A, and will cause it to rise at the same time the valve, 8, belonging to the gasometer, B, is open; thus the gasometer, B, will descend, and force the gas which was contained in it to escape through the pipe, *b*, into the exterior case, F F, the valves, 5 and 7, being shut or closed, as shown in the figure. The direction in which the gas is flowing, and the direction in which the gasometers are moving, are indicated by the small arrows, in fig. 10. In this position the projecting studs, *r* and *s*, before mentioned, are supposed to have come into contact, at the same instant, with the ends of the balance levers, *k* and *l*, and to have moved them upon their centres or fulcrums, in a sufficient degree, to cause the fluid contained within them, as aforesaid, to flow to their opposite ends, as shown by the dark shade, in the fig. 9, by which means, the ends to which the metal has flowed will preponderate, and by coming into contact with the elevated extremity of the small levers, *m* and *n*, will force them suddenly downwards, so as to change the position of the valves, as shown in the fig. 9, upon the drawing. In this situation the gas will flow from the service pipe, G, through the pipe, *i*, and valve, 7, into the gasometer, B, so as to cause the same to rise, and allow of a corresponding descent of the gasometer, A, the gas from which will escape freely through the valve, 5, and pipe, A, into the exterior case, F F. This action will continue until the projecting studs, *q* and *t*, which are affixed to the gasometer by the wires, *x* and *y*, as aforesaid, have come into contact with the balance levers, *k* and *l*, and have moved their extremities sufficiently to cause the fluid metal con-

tained within them, as aforesaid, to flow to the opposite ends of the said levers, when they will be caused to preponderate, and move the valves again into the position represented by the fig. 10. This action will continue to be repeated as often as the gasometers, A and B, arrive at the top and bottom of their course. The valves are caused by the operation of the small inverted pendulums or balance bobbs, *v* and *w*, to preserve the positions in which they may have been placed, until the balance levers, *k* and *l*, have been moved, by the projecting studs, sufficiently to cause the fluid metal within them to flow to the opposite ends of the said balance levers, at which period they will have come into contact with the elevated extremities of the levers, *m* and *n*, and will change the position of the valves almost instantaneously. By this arrangement, as long as the gas is permitted to escape from the exit pipe, H, and to be supplied through the pipe, G, the apparatus will continue in action; but as soon as the lights are extinguished, and the gas ceases to escape through the pipe, H, the action of the apparatus will cease, and will remain at rest, because the pressure of gas in the exterior case, F F, will have become equal to the pressure of the gas in the pipe, G, and within the gasometers, A and B, and will thus balance each other; but as soon as the pressure is relieved in the case, F F, by the gas being drawn off, the equilibrium will be destroyed, and the pressure of the gas within the gasometer, A or B, will cause them to reciprocate, and measure the gas from the service pipe, G, into the case, F F, as aforesaid. Particular care must be taken in adjusting the situation of the projecting studs, *q* and *r*, *s* and *t*, so that the pairs of the valves, 5 and 6, and 7 and 8, shall change their positions at the same instant, viz. the valves, 5 and 7, should open and shut simultaneously, and by the connection of the small levers, *m* and *n*, in the valves, 6 and 8, must of necessity open and shut simultaneously also, by which construction it will appear, from inspection of the small arrows shown in the figures upon

the drawing, that the gas could never pass through the apparatus without producing the reciprocating motion of the gasometers, A and B, as the valves which allow of the entrance and exit of the gas to the gasometer, are never open at the same time in the same gasometer. In order to effect the adjustment of the studs, *q*, *r*, *s*, and *t*, the wires and rods, *x* and *y*, to which they are affixed as before mentioned, pass through the tops of the gasometers, A and B, and are furnished with screw nuts, by means of which they may be raised or lowered at pleasure. In some cases I dispense with the fluid metal in the balance levers, *k* and *l*, instead of which I construct the balance levers with an arm rising from them in the centre at a right angle, and affix a bob or weight in the manner of an inverted pendulum, at the upper extremity of the said arm, in the same manner as the bobs, *v* and *w*, before mentioned, upon the arm or levers, *m* and *n*; the operation of the said weights or tumbling bobs would be nearly similar, within the hollow lever as aforesaid, as they would fall over suddenly, and change the position of the valves, as soon as the weights or bobs had passed the vertical line over their centre of motion.

The manner of arranging the said valves and giving motion to them, may be varied in many ways, still producing the desired effect, as above stated; and the mechanism or count-wheel-work, for registering the number of reciprocations of the gasometers, A and B, may be constructed and arranged in any of the ways which are at present known and in use for similar purposes, and may either be situated within the case, F F, as aforesaid, or the axis or pivot of the beam or lever, C, might be made to pass through a collar of leather, in the side of the external case, F F, and have the count-wheel-work situated in a small case, on the outside thereof.

Now, whereas gasometers, applied to the purpose of adjusting and equalizing the pressure of fluids, when flowing through pipes or tubes, are now in use, and have been

used previous to the date of the said hereinbefore in part recited letters patent, be it therefore known, that I do not claim the parts in fig. 7 of the drawing annexed, marked P P, *d d*, *m*, N, *n*, *o*, and *p*, as my invention; neither do I claim any right of exclusive privilege to the same, in conjunction with my said improvement; but only to those parts of the fig. 7 which, in the drawing annexed, is represented by shaded parts, having represented the other parts of the said fig. 7 merely for the purpose of better explaining the application of my said improvement, to the purpose last aforesaid; and a valve or sluice, such as is represented by the shaded parts, in fig. 7, of the drawing annexed, for the purpose last aforesaid; and also an improved apparatus, for the purpose last aforesaid, such as described at fig. 8, in the drawing annexed, and which is hereinbefore described as particularly applicable to the operation of adjusting or equalizing the discharge of water or other fluids, or liquids through a pipe or tube; and also an improved apparatus for registering and measuring the quantity of such fluids as may be caused to pass or flow through any pipe or tube, by means of gasometers having a reciprocating motion, such as is described by figs. 9 and 10, in the drawing annexed, being, to the best of my knowledge and belief, entirely new, and never before used in that part of his Majesty's kingdom of Great Britain and Ireland, called England; his said Majesty's dominion of Wales, and town of Berwick upon Tweed; nor in any of his said Majesty's colonies or plantations abroad. I, the said William Pontifex, the younger, do hereby declare this to be my specification of my said invention, and that I do verily believe this, my said specification, doth comply, in all respects, fully, and without reserve or disguise, with the proviso in my said hereinbefore in part recited letters patent contained, wherefore I do hereby claim to maintain exclusive right and privilege to my said invention, as hereinbefore set forth.

In witness whereof, &c.

Specification of the Patent granted to William Yetts, *of Great Yarmouth, in the county of Norfolk, merchant and ship owner, for certain apparatus to be applied to a windlass.* Dated February 28, 1824.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. *Now know ye,* that in compliance with the said proviso, I, the said William Yetts, do hereby declare the nature of my said invention to consist in securing the forward end of a lever bar, such as is hereinafter more particularly mentioned and described, by means of a perpendicular and diagonally supported standard and bearing, which constitutes a part of my said apparatus; and also in an additional pall, placed abaft, and lying against and partly round the windlass barrel, and acting upwards from the deck, which constititutes the remaining part of my said apparatus. And in further compliance with the said proviso, I, the said William Yetts, do hereby describe the manner in which I perform my said invention, by the following description thereof, reference being had to the plate annexed, and figures marked thereon, that is to say:

DESCRIPTION OF THE ENGRAVING.

Fig. 11 (Plate I) is a perspective view of a ship's windlass, with my said apparatus applied thereto: B is the lower part of the safety pall, fastened through the deck to a beam under it, and moving with a joint at *e*: C is the upper part of the safety pall, moving on a joint at *f*. These two parts of the safety pall are kept to their place against, and partly round, the windlass barrel, by means of a chain, S, which, in order to allow of the necessary play for the motion of the palls over the ratchets, is attached, at one end, to the flat spring, *g*, which is fixed to the pall bit, as shown in the figure: *r r* are ratchets on one side of the ordinary cogs on the windlass barrel: there are a similar set of ratchets on the other side of the cogs, but which, in this view, are hid by the rim or flange, X. On the

under side of each part of the safety pall are teeth, which take into the ratchets, *r r*, and thus assist the ordinary palls of the pall bit, in preventing the windlass from revolving in a direction forwards: X X are rims or flanges, raised on each side of the ratchets, *r r*, for the purpose of keeping the two parts of the safety pall in their proper place; *t t* are the bottom parts or feet of the perpendicular standard, described more particularly at fig. 15. Fig. 12 represents a perspective view of the said safety pall, showing the teeth or catches, L L, which take into the ratchets, *r r*, fig. 11. Fig. 13 represents a section of the windlass barrel, showing the form of the ratchets, *r r*, and their relative positions with respect to the ordinary cogs of the barrel, as also the rim or flange, X X. Fig. 14 represents a section of the windlass barrel of the said safety pall, and of the ordinary palls of the pall bit; and this figure is given for the purpose of describing the manner of setting the safety pall for use, which is as follows (that is to say), the safety pall being only intended to act for the purpose of resistance, when a more than ordinary strain is brought upon the ordinary palls, the teeth of the safety pall should be set about one-eighth of an inch clear of the ratchet opposed to it, when the ordinary pall bears close against its corresponding cog; then, when any extraordinary pressure against the ordinary pall bit causes it to spring off, the safety pall takes against the ratchets, and adds its resistance to the ordinary palls: *e e*, in this figure, are the ordinary half palls; *m m m* are the ordinary palls, in their resisting position: B and C are the two parts of the safety pall, at the distance of one-eighth of an inch from their corresponding ratchets. Fig. 15 is a representation of a section of the windlass, showing that part of my said invention which refers to the forward end of the lever bar: H is the lever bar, passed through one of the handspike holes, in a horizontal position, the after end, P, being retained by a long hook bar going into an eye bolt in the deck at the end, N, and swinging on an eye joint at the end, P. The part marked G is to represent the

perpendicular handspike hole, corresponding with the horizontal one which intersects it. Now, so far as this fig. 15 is hereby described, I do not claim any novelty or exclusive privilege; but only in the parts hereinafter described, as follows, (that is to say:) O is the forward end of the lever bar, which it will be seen enters into the bearing, R, which is supported from the deck by the perpendicular standard, W, and which standard is supported in turn by the diagonal bar, D, which is fastened to the deck at F. These standards and bearings, and the diagonal bar, as also the safety pall, I make of cast iron, and of the proportions represented in the plate annexed, the size of course varying with the size of the windlass. Now whereas I am the true and first inventor of the whole hereinbefore described lever bar and long hook bar, as shown in fig. 15, and, in fact, of the mode obtained thereby of preventing the windlass from revolving in any direction; but whereas I have published heretofore, and have allowed the public use of so much of the said lever bar as is described by the letters H P and N, I therefore do not claim exclusive privilege to that part thereof. But such a bearing and standard as aforesaid, for securing the forward end of the lever bar, and such a safety pall as aforesaid, placed abaft the windlass, and acting upon it upwards from the deck, in manner and form aforesaid, being, to the best of my knowledge and belief, entirely new, and never before used in these kingdoms, I do hereby declare this to be my specification of the same; and that I do verily believe this, my said specification, doth comply in all respects fully, and without reserve or disguise, with the proviso in my said hereinbefore in part recited letters patent contained, wherefore I do hereby claim to maintain exclusive right and privilege to my said invention.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

The patent apparatus has been submitted to the inspection of the Commissioners of his Majesty's Navy,

upon whose report the Lords of the Admiralty gave immediate orders for the fitting of the Surly, the Swan, and the Basilisk cutters.

It has also been inspected by the Committee of the London Ship-Owners' Society, as well as by some of the most respectable and experienced ship-owners, ship-masters, &c., at the port of Great Yarmouth, who have expressed their unqualified approbation of the invention, and from whom the patentee has been honoured by the most flattering and satisfactory testimonials.

The apparatus, which consists of bar-standards, lever-bars, and a safety-pall, combines neatness in appearance, with simplicity of construction, and is not in the least degree cumbersome.

The properties peculiar to the bar-standards and lever-bars are; that they render the windlass, at the time of riding at anchor, a perfect fixture. Their power over the windlass prevents the possibility of its bending or yielding, in any direction, to the strain of the cable, and wholly relieves the palls and windlass-bits from pressure; consequently, the inconvenience so frequently accruing from a straining of the seams at the deck, may be, by these means, entirely prevented. The lever-bar may be shipped or unshipped instantaneously.

The safety-pall is calculated to relieve the fore-palls from excessive pressure, and which not only affords effective security to the windlass, whilst riding, but it also imparts that security at the time of heaving; for, were it possible that all the fore-palls could give way, the safety-pall would most effectually prevent the windlass from flying round; added to which, its peculiar construction renders it impossible to be upset, even when heaving against a head sea; neither does it occasion any impediment to the required rotatory motion of the windlass, and may be fixed or unfixed with the greatest facility.

The daily recurrence of the loss of lives and property, occasioned by windlasses giving way, renders it superfluous to descant on the great advantages to be derived

from the adoption of the patent apparatus; it is however to be hoped, that this invention, so pre-eminently calculated to avert the frequency of mischief, from the upsetting of palls, at the time of heaving, may be considered by those conversant in nautical affairs, as an attainment of a most important desideratum, in regard to the construction of the windlass.

Particular attention should be paid in fixing the barrel upon the body of the windlass, for on that greatly depends the proper action of the safety-pall. To do this effectually, place a stool or trestle the exact height of the centre of the after-part of the windlass, on which lay a piece of board, broad enough to extend across the ratchets on each side of the barrel within the flanges, in order that the barrel may be adjusted by the passing of the ratchets against the piece of board.

Observe that, on each safety-pall is inscribed the height of the windlass, from the centre to the deck amidships, to which it is adapted; but, should circumstances require the windlass to be fixed higher than what is inscribed on the safety-pall, it will only be requisite to elevate the deck-plate by means of a small chock. Let the teeth of the safety-pall be set about one-eighth of an inch clear of the ratchets opposed to it, when the ordinary pall bears close against its corresponding cog. To effect this—place a piece of spline, one-eighth of an inch thick, extending to the face or flat surface of a ratchet on each side, for the lower teeth of the safety-pall to hang upon; then—proceed to fix the deck plate, and bore the holes for the deck bolts, which must be done with great exactness, in order that, when the shackle bolt be shipped, the safety pall may lay even against the barrel.

The spring box must be morticed into the pall bit a sufficient depth to admit of the plate (which is intended to secure it from the weather), being nailed on flush with the pall bit. The bottom of the spring box must also be fixed as close as possible to the upper part of the pall plate.

In arranging the length of the chain, let it be so divided, that the link may just touch the extremity of the hook of the spring, but if, when cut, it should prove rather too short, it may be lengthened by flattening the links.

The bar standards should be placed as near as possible to the windlass, allowing it only sufficient room to revolve, and they may be morticed a little way into the deck; if, on the contrary, they be too short, they may be elevated by placing a small chock under each foot.

The fore end of the lever bars are to be shortened, until the iron bands at the after end go close to the windlass, when placed into their situation.

Fix the eye bolts at the deck so as to allow the hook bar when shipped to be quite perpendicular.

Specification of the Patent granted to David Gordon, *of Basinghall-street, London, Esq. for certain improvements in the construction of carriages or other machines, to be moved or propelled by mechanical means.* Dated December 18, 1824.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said David Gordon, do hereby declare the nature of my said invention by the following description thereof, and the manner in which the same is to be performed and carried into effect by the drawing which is hereunto annexed, reference being thereunto had, and to the figures and letters marked thereon, as follows, that is to say:—My invention consists in a particular arrangement of mechanism hereinafter to be described, for the purpose of propelling or driving a locomotive carriage over a rail-way or common road, or for propelling ploughs, harrows, or other agricultural machines or implements. This action is performed by the operation of a number of rods or pro-

pellers, which rods or propellers are attached, at one of their extremities, to a like number of cranks, situated upon one common axis across the carriage, near to the hind part thereof, whilst their outermost extremities are formed, as will be hereinafter described, so as to be capable of seizing the ground in a sufficient degree to propel or drive the carriage, or other machine aforesaid, forwards, being at the same time connected by rods or cords with the extremities of certain levers, which are operated upon by an equal number of excentric shapes or wheels, the said excentric wheels being all fixed upon one common axis, receiving its rotary motion by a pair of equal cog wheels from the main crank axis. By the said arrangement, as the crank axis and excentric wheel axis are caused to revolve with equal velocities by any adequate power applied to them, the rods or propellers aforesaid will be forced or thrown out backwards (or in the contrary direction to that in which the carriage is desired to be moved), and by the form or shape of the excentric wheels, the outermost extremities of the propellers will only remain in contact with the ground at the time when they are moving with the greatest velocity, or nearly so; at other times the extremities will, by the action of the excentric wheels, be taken up entirely off the ground. Thus a continuous action will be kept up to propel the carriage, or other machine or implement, forwards. Fig. 1, (Pl. II.) upon the drawing which is hereunto annexed, will serve to explain the form of a carriage which I propose to employ for the said purpose. It is constructed according to a plan for which I obtained a patent, dated 14th day of August, 1821. This carriage has only three wheels, and is therefore guided with much facility; besides which, it presents a large uninterrupted space, near the ground, to receive and contain the necessary machinery, steam engine, or other prime moving power. The space marked A A A A, is devoted to the engine and machinery. The space, B B B B, is devoted to the conveyance of luggage. The front part, C C C C, is

adapted to receive four inside passengers, or four passengers of the first class; and the part, D D D D, is adapted to receive twelve outside passengers: E represents the conductor's seat, which is situated in front, so that he may be capable of looking out clear over the road which the carriage is to travel. The conductor is also supposed to possess a controul over the entire machine, by having rods or cords coming to him from all such parts as may require attention; and by the whole carriage, machinery, and all being mounted or suspended upon springs upon the bed or part to which the wheels are affixed, the motion would be very easy. Figs. 2 and 3 upon the annexed drawing will serve to explain the mechanism for propelling the said locomotive carriage forwards, upon a rail-way or a common road: F represents the main crank axis, which in the drawing is supposed to have eight cranks formed out of it, each of which said cranks has a rod or propeller jointed to it, similar to what is represented at G. These propellers I construct of metal, and make them hollow, in the form of tubes, so as to contain a wooden rod within the tubular part thereof. The outermost extremities of the propellers are secured to arched pieces of metal or feet, g; the curve of which arcs is performed by a radius, about equal to the radius of the cranks, F; and the under surfaces of the curves or feet are shod, according to my improvements, with pieces of cork, short hair, whalebone, or other suitable material, set on end like a stiff hard brush; the said substances to project a short distance beyond the points or extremities of iron teeth. Thus, if the flexible material should yield in any considerable degree, the points of the iron teeth aforesaid would come into contact with the ground, and would act as propellers to advance the carriage forwards.

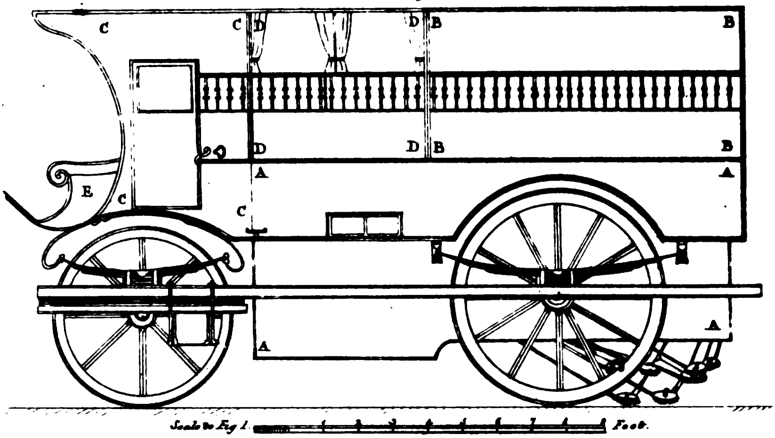
During the winter, when the surface of the ground is covered with ice, or hard snow, I intend to furnish the under surfaces of the said curves, or feet, with steel points, which may project sufficiently to seize the ground

and propel the carriage forwards. The uppermost parts of the curves, or feet, *g*, are loaded with lead, or other ponderous material, in order to render them sufficiently heavy to operate in a proper manner upon the ground. The extreme ends of the propellers are formed on the upper surface to a joint or knuckle, *h*, and have slight metal rods, H, jointed to them, which said rods proceed upwards, and are attached to the extremities of a number of arms or levers, I, moving upon a fixed centre at K. The levers, I, are guided in their motion sideways by sliding through openings, or slits, in a kind of curved grating, *l*, *m*, and they have a small pulley, or roller, *n*, working into a grove, or mortice, in a projecting piece from the under side of each lever. The small rollers, *n*, are adapted to bear upon the upper surfaces of the shapes, or excentric wheels, L, which said wheels are mounted upon an axis, or shaft, M, turning in bearings supposed to be screwed to the carriage frame. The main crank axis, F, is furnished with a cog-wheel, *f*, at each end thereof, as seen at *f f*, in fig. 3, one of which wheels is represented at *f*, in fig. 2, by a dotted circle only; this wheel communicates motion to another cog wheel, of equal diameter and number of teeth, fixed upon the end of the excentric wheel shaft, M. Thus both the said shafts are caused to revolve with equal velocities, and the shape or situation of the curves, or excentric wheels, is such, that the levers I, by the aid of the rods, H, are adapted to allow the under sides of each of the propelling feet, *g*, to remain upon the ground during the motion of the crank from No. 1 to No. 8, and then to raise the feet, *g*, up from the ground by the excentric part of the wheels, L, from No. 8, by No. 7, to No. 6, each of the feet remaining clear of the ground, from No. 6 to No. 2, and then descending at the part from 2 to 1; by this means, as there are eight cranks represented in the drawing by the figs. 2 and 3, so there would be eight propellers, G, and eight rods, H, with their levers, I, and excentric wheels, L, which, by operating in a regular succession, would tend to produce a continuous and

uniform action upon the carriage to propel it forwards, the cranks being so arranged relatively to the propellers that the said propellers may come upon the ground, first on one side of the centre line of the carriage, then upon the opposite side of the centre line, thereby avoiding any degree of side motion or riggling of the carriage along the ground; and in order that the cranks may be sufficiently stiff, I propose to insert a support or collar between every pair of cranks, as will appear evident from inspection of the parts, *q q*, fig. 3. Each of the propellers, G, will be guided in its motion sideways, by working through a groove or slit formed in the lower part or bottom piece of the hinder part of the carriage, as represented by *o p*, in fig. 2. They will each of them have a line attached to it, being conveyed over pulleys along the uppermost part of the carriage to the conductor, in order that he may arrange the working of the same according to the nature of the road over which he has to travel, or in turning round a corner; this latter movement of raising up some of the propellers from the ground will act very conveniently along with the simple turning of the front wheel of the carriage. I should at the same time recommend that the wheels were each provided with a gripe or break, the handle of which were within the power of the conductor, so that he might descend a hill without difficulty or risk; and in travelling up hilly ground it will be found very advantageous to have transverse pieces of wood, or other sufficiently hard material, disposed across the breadth of the road, between the lines of rail-way, the said pieces being placed at about five or six inches asunder, as may be found most convenient for the feet of the propellers to act against in propelling the carriage. The aforesaid mechanism will be found equally applicable to the propelling of ploughs, harrows, or other agricultural machines or implements; but the feet of the propellers will require to be made larger in proportion as the machine is intended to travel over uneven or soft ground.

I have now described, with reference to the annexed

Fig. 1.



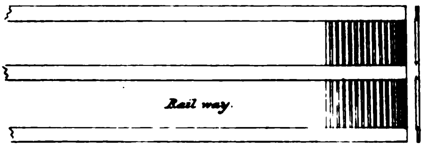


Fig. 3.

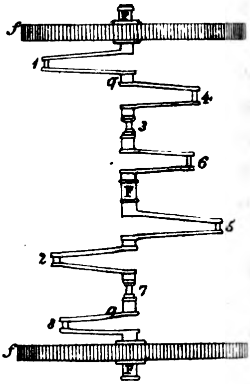


Fig. 2.

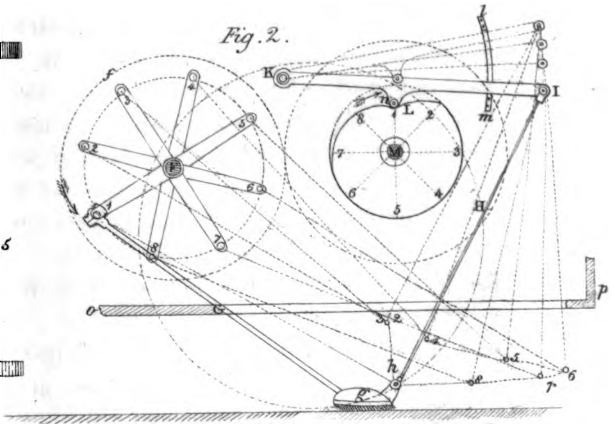


Fig. 4.

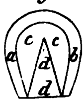


Fig. 5.

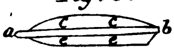


Fig. 6.

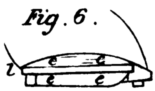


Fig. 7.

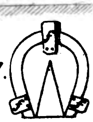


Fig. 8.

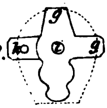


Fig. 9.

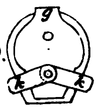


Fig. 10.

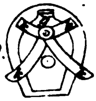


Fig. 11.

Fig. 12.

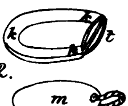


Fig. 13.

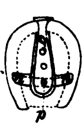


Fig. 14.

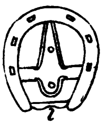
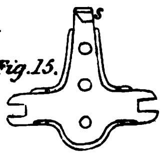


Fig. 15.



drawing, my invention of certain improvements in the construction of carriages or other machines, to be moved or propelled by mechanical means, and I do hereby declare, that I confine my claim of invention to the following particulars, viz. First, the general arrangement of the machinery or apparatus for propelling by mechanical means carriages, ploughs, harrows, or other agricultural machines or implements as hereinbefore described, with reference to the annexed drawing. Secondly, I claim the exclusive right of having the rods or propellers in such carriages, or machines, jointed to cranks situated at different angles upon the same axis, so that the extremities or feet of the propellers will act upon the ground in succession, at a time when they are moving with the greatest velocity, or nearly so. Thirdly, I make claim to the curved form of the under surfaces of the feet of the propellers, being described by a circle of about the same radius as the radius of the cranks which move them, in order that the said feet may accommodate themselves more easily to the ground, and especially in the act of turning. And fourthly, I claim the right of employing bristles, whalebone, or other pliable material affixed to the under surface of the curved feet of the propellers, as a substance to come into contact with the ground, and hold sufficiently thereupon.

The form and proportion of the various parts of the apparatus constituting the mechanism aforesaid, must be varied according to the circumstances of the case, without departing from the object of the invention, as hereinbefore described and set forth.

In witness whereof, &c. &c.

OBSERVATIONS BY THE PATENTEE.

Until a better moving power shall be obtained, I propose to use a high-pressure steam engine, with two cylinders, so as to dispense with a fly-wheel, the boiler of which I recommend to be on the American principle of

multiplied coils of small copper tube; thus affording a light and a large surface for the fire to act upon in a small space, in which case no possible danger from bursting could arise. The water to be forced down a pipe along the flue, and the steam to come out below, at the hottest part of the tube. Rain water to be used; and to save it and the heat as much as possible, the exit pipe from the steam engine ought to be inserted 6 or 8 inches into the water cistern; the end of the pipe to be like the rose of a watering pan, the orifices of which to be small tubes about an inch or two long, the sum of the area of which to be equal to the area of the exit pipe. By this means there would be little waste of water, and it could be pumped back into the boiler so long as the water in the cistern can be kept under the boiling point of water in vacuo.* In some degree this arrangement would make the engine a condensing one, and at no time would the pressure on the exit steam be an impediment worth consideration. Although my locomotive carriage is adapted for common roads, and for ploughs, harrows, &c. yet it is upon rail-roads, ice, and snow, that the greatest advantage would be gained, and where the rapidity would be immense. The rail-road represented in the plate is intended to be made of wood, and that part of it upon which the wheels are to move ought to be covered with very thin sheet iron. Even in this country such a species of rail-road would not be expensive; but in some parts of Europe, Russia, and America, it would cost less than a well-made common road. The stumps of trees, in fact, would in general be all the foundation required. The following are the principal uses to which I think the locomotive carriage above described might be put:—

1st. To propel carriages on common roads or fields.

* This species of boiler and cistern I recommend for steam vessels on long voyages, and where the cistern could always be kept at the required low temperature, by surrounding it with a plate of sea-water. To keep the cistern in a locomotive carriage cool, a stream of air might be employed.

2d. To propel ploughs, harrows, &c.

3d. To propel carriages on rail-roads.

4th. To propel carriages upon skates on snow and ice.

5th. To propel carriages over hot sandy deserts; and

6th. To propel warlike carriages.

In the three last cases the passengers, engineer, and guide, would be protected from cold, heat, and warlike missiles.

To such persons as may be disposed to try my invention I will be happy to give every facility and information in my power.

Specification of the Patent granted to ROBERT DICKINSON, *of Park-street, Southwark, Surry, Esq. for an improvement in addition to the shoeing or sloping and treatment of horses' feet.* Dated Aug. 5, 1828.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said Robert Dickinson, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows, that is to say:—It consists in the formation or construction of peculiar implements, which I call resters, and in the application of the same to the feet of horses, for the purpose of supporting them, and producing ease and comfort to such animals, as well as for promoting the healthy state of their feet, by affording them protection, and maintaining a proper degree of moisture; and likewise of certain additional parts to be used in the shoeing of horses for work, as hereinafter described. In all the ordinary constructions and applications of horses' shoes, the iron shoe is so placed and fixed to the hoof, that the whole weight of the animal, when standing, bears upon the outer edges of the sole, and the

frog, or tough elastic central part of the foot, which nature evidently intended should bear a portion of the weight, is raised and removed altogether from contact with the ground. By this means one of the most considerable members of the foot is thrown completely out of action, and the whole weight of the animal is suspended or hung (as it were) upon the crust or front circumference of the hoof. The proper distribution of pressure upon the foot, by throwing a portion of it upon the frog and sole, is very generally admitted; and it is a want of proper attention to this circumstance, that produces some of the disorders to which the feet of horses are liable. The principal objects of my invention are, therefore, to produce this pressure on the frog and sole; to make its quantity variable, according to the exigency of the case; and to maintain such a proper quantity of moisture at all times upon the foot, as shall prevent its growing hard and cracking, and as shall insure the healthful expansion and growth of its parts. To produce these desirable ends, I use the apparatus or implement shown, flatwise, or in plan, at fig. 4, (Plate II.) and in section; or, as it would appear, if cut through longitudinally, at fig. 5; its size, form, and dimensions, varying with that of the foot to which it is to be applied, or the exigencies of the case; and this apparatus I call a rester. It consists, in the first place, of a base or stiff piece of material, *a*, *b*, for the purpose of giving strength and consistence to the apparatus; and on this account I form it of thick buff or tanned leather; carpet, or woollen cloth painted on one side; felt, such as is used for hat making; canvass, stiffened or strengthened by painting, varnishing, or cement; or tarpaulin or floor cloth, or any similar materials that will bend, so as to permit its introduction into the shoe, and yet is sufficiently rigid or stiff to maintain its place when once put in. To the upper part of this base, or that which goes next to the horse's foot, I sew, stitch, or otherwise attach and fix, two pieces of sponge, thick and porous felt, sheep's skin, tanned with the wool

upon it, or other soft elastic and absorbent material, as at *c c*; or else I form the whole of one piece, in which case the triangular portion, *d d*, must be cut out and removed, so as to make room for the frog of the foot to enter it, and bear upon the base of my apparatus. The projecting pad, *c c*, formed as aforesaid, must fill up the whole sole and hollow of the foot, and surround the frog as nearly as possible; consequently, it will require more or less projection, according to the depth of the foot to which it is applied, and which it should fit as neatly as possible, its intention being to retain water or any other fluid with which it may be moistened in contact with the foot, and thus to keep it in a damp state as long as may be required. To the underside of the said base, *a b*, or that side which is next the ground, I also sew or otherwise attach a pad or cushion, *e e*, fig. 5, which must be of such size as to be contained within the opening of the horse shoe, and of such thickness as to exceed that of the shoe, or its elevation above the ground; consequently, whenever the foot is put to the ground, the bottom of this lower pad, *e e*, will come into contact with it, and will receive the pressure, which will be transferred to the base, *a b*, and from thence to the frog and sole of the horse's foot. In order to apply these resters to horses' feet, the stiff projecting edge of the base, *a b*, is to be introduced into the hollow space that occurs between the arch of the sole of the horse's foot, and the top surface of the shoe, as shown in fig. 6, which is a general section of the horse's foot, with the shoe and the rester applied within it. In some cases where, from want of space between the shoe and the foot, or other cause, it may appear desirable to use a base or middle piece, *a b*, of little rigidity or stiffness; as, for instance, when it is made of hat felt, I then cause small metal projections, such as are shown at *f f f*, in fig. 7, to be rivetted upon such sole, their length being just sufficient to take sufficient hold of the inside of the shoe, to hold the rester in its proper place; and in

other cases, particularly in disordered feet, when it may be desirable to remove and replace the rester frequently, I make use of the holdfast of thin plate iron, or other metal, shown in different forms, at figs. 8, 9, and 10, in which the fixed points, *g*, *g*, pass between the foot and the iron shoe; while those at *k*, *k*, are moveable upon the rivets *i*, *i*, as centres, and may be turned backwards and forwards to remove or fix the rester at pleasure. In some cases likewise, instead of attaching the pads, *c*, *c*, fig. 4, to the base *a*, *b*, I make them of the same materials as aforesaid, but loose and detached as at fig. 11; and in this case, after causing them to fill up the hollow of the foot fully and properly, I introduce a base, either with a stuffing or padding of uniform thickness, or without any padding or stuffing at all, on the inside, and I fix and attach it by any of the means aforesaid. All the above described apparatus, it must be understood, is required to be applied only to horses in the stable, and not when they are at work. In order to meet and give support and pressure to feet of the greatest depths, I form a double bag, that is, a bag with a division or partition between the two sides, with a strong, stiff, projecting edge, rendered so by paint or varnish, see *k*, *k*, *k*, fig. 12; which rim or margin is for the purpose of passing between the foot and the shoe, to hold the apparatus in its place as aforesaid. The mouth, or opening of these bags or pockets are at the heel, and by these I introduce first a sufficient quantity of packing or stuffing of sponge, felt, wool, shavings of leather, or other soft absorbent and elastic materials, either to fill up the hollow of the foot, and to produce the requisite pressure and moisture; I then introduce into the lowest pocket or division, or that next the ground, a small pallet or piece of wood, leather, or other sufficiently hard substance, cut into the form shown at *m*, fig. 12, or else I fill such pocket or division with shavings of leather, bits of rag, hay, or other substances, until I have produced the necessary pressure upon the frog; when the wooden or

other pallets, or packings, *m*, fig. 12, are made use of, it will be necessary to have them of different degrees of thickness, in order to suit different depths of feet, and make them project beyond the shoe: another means which I make use of is shown at fig. 13; it consists of an artificial frog of iron, or other material, *p, q*, having a spring of steel or hammered iron, fixed transversely across it, as at *n, o, n*, the ends, *n, n*, of this spring go between the shoe and the foot; and as the spring itself is arched or bent upwards, having its ends inclined towards the shoe, and is fixed to the artificial metal frog, *p, q*, it will of course bear that artificial frog upwards against the real frog of the horse's foot with a degree of strength or pressure, equivalent to the power of the spring, which of course may be made greater or less at pleasure, by the application of the aforesaid inventions, or such of them as are most suitable to the particular case, it will be seen that a much more efficient stopping of the foot pressure on the frog and sole, and application of moisture, are obtained than by any of the means now used for such purposes; I not only, however, extend my invention and improvements to horses' feet when in the yard or stable, but likewise apply it to them when at work, by the following means: In the first place, having prepared and cleaned the foot, and put it into a proper state for receiving the shoe as usual, if the foot is very hollow, and I find it expedient, I stop round the frog and fill up the hollow of the horse's sole with a detached padding, so thick as will make it nearly level when the shoe with its appurtenances is put on, and this is best formed of sheep skin, tanned or tawed with the wool on it, and attached either simply to the iron frog before mentioned, by rivetting, or stitched at its margin to a piece of cloth, strong leather, or other material, to give it stiffness and protection, and in which I form a pocket, if necessary, wherein to introduce stuffing as before described, for the purpose of filling up a more than usually great hollowness of the foot, in which case the iron frog

is to be fastened by rivetting, or otherwise to the under material or piece of cloth as before described, or to a piece of thick felt, painted canvas, or any of the strong substances hereinbefore named, as proper for making the base, or any other substance which may be fit and proper for the purpose. This must be cut to the exact form of the external edge of the foot, as shown at fig. 13, and I then strengthen or protect the under side of such piece of material by an artificial frog, or centre piece of iron or other material, either with or without the spring, *n*, *n*, shown in fig. 13. This metal plate, or artificial frog, is to be fastened with rivets, having wide washers, or plates, to render them more secure, to the said piece of material; and having, if necessary, first stopped and prepared the foot as aforesaid, I next place the piece of material, so cut out and protected, over the same, and then apply the shoe over this, as shown by the dotted line in fig. 13, and nail it to the hoof in the usual manner, when the nail will pass through the said piece of protected sheepskin, leather, or other material, which will thus be firmly attached to the foot, and will be immoveable until the shoe is removed. The foot and shoe, when so prepared and finished, will have the appearance shown in fig. 14, when viewed from the under side. In a foot so prepared and shoed, it is evident, that any required degree of pressure, or none at all, may be produced at pleasure, by adopting the spring shown in fig. 13. It will also be evident, that from the absorbent nature of the materials, or stopping, introduced into the hollow of the foot, it will always be kept moist, from which the most beneficial results may be expected. I likewise occasionally turn down the edges of the metal plate, or false frog, *p q*, figs. 13 and 14, not only to give it greater strength, but because it is an excellent preventive against slipping. This artificial frog might be made in one piece, as at fig. 14, or as shown detached from the shoe at fig. 15, having a hooked point at s, which may be used or not; but by making them in two, and

rivetting them together, as at fig. 13, the substance and strength of the spring, or the depth, shape, and substance of the frog, may be suited exactly to the exigency of the case. Lastly, I declare, that although I have described the various forms, or shapes, of the several parts of my invention and apparatus, and the materials of which I conceive they are best made and constructed, yet, as my invention does not consist of these alone, I do not confine myself to them, inasmuch as it may be necessary to vary them to suit particular cases. The essence of my invention, and the only part of the same which I claim the whole and exclusive right and benefit of under my aforesaid hereinbefore in part recited patent, is the apparatus last above described, namely, the artificial frog of iron, or other metal, with or without a spring, and the soft and elastic packing of sheepskin, with the wool upon it, or other fit material, as hereinbefore mentioned; and I therefore claim the use of all such materials as possess the requisite properties of retaining moisture, and protecting and assisting the foot when used and applied in the manner described by figs. 13, 14, and 15; that is to say, when used and nailed upon the foot, in conjunction with the shoe as aforesaid. The varnish before alluded to, which I make and use, is formed of five ounces of shell lac, with one ounce of turpentine, and 32 ounces of alcohol; and the paint which I prefer is that known by the name of Ribblesdale's rock cement, when mixed with common oil paint.

In witness whereof, &c. &c. &c.

Description of a simple apparatus for lifting heavy goods from the ground into carts or waggons. By Mr. J. W. Boswell.

Communicated by the Author.

It has often appeared to me, that society would be much benefitted by communications published relative

to useful matters, which may have occurred to individuals in their several pursuits or employments, and which, from various circumstances, they may not be able to render lucrative to themselves by the exclusive right of a patent, or other means, though valuable for their application to purposes of acknowledged utility.

Influenced by this opinion, I have communicated several papers, which appeared to me to contain matters of this description, for publication at various times, and should have transmitted others, but have been prevented partly from the pressure of my business, and partly from considerations with which it is not material to trouble your readers.

Some of these I have had the satisfaction to see adopted by gentlemen who had more opportunity to turn them to practical utility than I had. One gentleman, who made use of my improvements on the Schemnitz Engine for Raising Water, has had the liberality to acknowledge his having taken his ideas from my paper relating to it in Nicholson's Philosophical Journal, in what he published respecting this matter. And another gentleman has done me the honour to take out a patent lately for my Method of Moving Ships by Compressed Air, which was published in the Number of the Repertory of Arts for April, 1815; which, however, I presume, cannot be of much use to him, as, by this publication, I have not only established the priority of my claim to the invention, but of course have rendered his patent null and void.

These two instances will, I hope, give some proof of what I have asserted relative to the value of such publications, and excuse me for again taking up some more of your pages with similar communications.

Having had occasion, some time back, to send off several large cast iron vessels, some of which weighed considerably more than a ton weight, and not being provided with a crane to lift them into the cart, I had to contrive some method for the purpose, less expensive, troublesome,

and dangerous, than the united efforts of a number of men.

I had some deal spars, a few planks, and some strong cord that had served for binding pearlash casks; but nothing else that could be at all applied to the use desired; with these, however, I made a shift to construct an extemporary apparatus, which I found extremely convenient for my design, very simple, easily put together, and of no cost; and which, as others may find it, or one of a similar kind, equally serviceable, I will describe at large.

With three of the spars I erected what is commonly (though improperly) called a triangle, united by cords together at top, and diverging sufficiently at bottom to make it steady; to the top of this I fastened, by several rounds of rope, a strong beech plank by the middle, placing it edgeways, (or with its plane vertical to that of the horizon,) which plank was near 14 feet long, 10 inches broad, and about $2\frac{1}{2}$ inches thick; to one end of this plank I fastened a large scale, used for weighing, and secured it well by triple cords at each angle. I then brought down the other end of the plank sufficiently low to raise the scale above the level of the cart, and in this position had it bound firmly by several rounds of cord to the vessel which I desired to raise: I then had the scale loaded with heavy matters, (weights, pieces of iron, and bricks,) till it balanced the vessel, after which it was easily raised and placed in the cart, by backing the horse till it came under it in the proper position; and then, by taking the weights out of the scale again, the apparatus was as readily disengaged.

I found this simple apparatus so convenient for loading carts, that I used it several times afterwards for lifting casks of Epsom salts, and other matters, under 200 cwt.; which leads me to suppose, that one on the same principle would be found very useful for raising any weight greater than what one man could lift with facility, and that it

would be advantageous to have one erected permanently for the use of any business where heavy weights are required to be raised from the ground into carts or waggons.

When an apparatus of this kind is wanted for permanent use, I would recommend the following alterations to be made in its construction. Instead of three spars placed as before described, a single post might be fixed erect, about 10 feet high, and be well secured from inclining from the perpendicular position by the usual means; in the top of this post a hole should be bored vertically, 1½ foot deep at least, and be secured by an iron cap well fastened, having an aperture directly over the hole; the use of this hole is to receive the shank of a piece of strong iron, forked above to receive the centre of a balance beam, and having holes in the forked parts for a gudgeon to be passed through them and the beam; a scale should be fastened well by chains to one end of the beam, so as to be about four feet from the ground when the load was fastened to the other end of the beam, or a little higher than the bottom of a common cart, and the other end of the beam should be furnished with a short chain and hook for taking up any packages or other matters which were required to be raised into carts. A number of half-hundred weights should be also provided, equal collectively to the weight of any package usually sent off the premises. The square half-hundreds, which are made with a handle sunk in the body of the weight, would be most handy for this purpose, as they could be readily piled one on another in the scale, when required, without any danger of falling off; weights of other sizes might doubtlessly be used for the same purpose; but it seems to me, half-hundred weights could be raised quicker into the scale than larger or smaller sizes, for a given load, by men of ordinary strength. It will be obvious, that the use of the forked support for the balance beam having a shank descending into the body of the post,

is to admit of the beam being turned round horizontally, for the greater convenience of putting goods into carts, while they remained in a fixed position; for which reason the shank should be well rounded above, and fit properly in the cap, and should also have a socket let down into the body of the post to sustain its lower extremity, to admit of its being turned round with more facility.

As this apparatus serves most of the purposes of a crane, if it should ever come so far into use as to require a name, I would propose to call it the *Balance Crane*.

All the cranes hitherto used have a defect, from which this, which I propose here, would be free, which is, they require very near as much time to raise a small weight as a large one; for though the winch, or other operating part, which puts the machinery of the crane into motion, may be turned round somewhat quicker for the small weight; yet as it must be turned round an equal number of times in both cases, the different degree of speed which a labourer *will* use with the smaller weight will not be found of much benefit; whereas with the balance crane, the time and the labour must be exactly proportionate to the load to be lifted; ten hundred weight only requiring half the number of weights to be lifted which would be necessary for a ton, and a smaller load proportionally less.

I have seen some cranes where this defect was attempted to be obviated, by having two or three toothed wheels of different sizes on one axle in the machinery of the crane, so fixed, that the pinion turned by the winch or handle of the crane, might be transferred from the wheel of the larger diameter to that of the smaller size, when required for a smaller load; but it is obvious that this contrivance could have but a very narrow limit, and could only vary according to the number of wheels placed for that purpose, the addition of which proportionally increased the expence of the crane, and its complication, while the principle of the balance crane enables it to vary its power, and the time of the operation, exactly in proportion to the load,

without any complication of parts, or additional expence of construction.

I have a plan for another crane on similar principles, which I think considerably superior to those described here, when intended for constant use; and which, when wanted for raising great loads, frequently would cost but little more than the last; but to make this known as it should be, I must wait for some better opportunity.

Description of a gun-carriage for naval use, and jointed ramrod. By Mr. W. Pringle Green, *Lieut. RN.*

From the Transactions of the Society of Arts, &c. Vol. XLII.

The large silver medal of the Society was presented to Lieut. Green for this communication.

WITH AN ENGRAVING.

By the present mode of fighting a cannon on board ship, the apparatus to each consists of two side-tackles, for the purpose of running out the gun after it has been fired and reloaded, a train tackle, a rammer and sponge attached to one handle, a rammer and worm to a second, a rope rammer and sponge, and a crow-bar and handspike. There is also a ladle to every fourth gun, for the purpose of drawing out the shot when the powder does not ignite, owing to the gun being wet, or foul on the inside.

The before-mentioned apparatus lumbers the deck; and by the present mode of working, seven, nine, thirteen, or more men are required to each, according to their calibre; this prohibits the merchant shipping from fighting all their broadside-guns, and from carrying one or more heavy cannon, by which they could in many instances disable the ship chasing them, and thereby escape capture; and when several vessels are in company at sea, or in an exposed harbour, could form a formidable battery, bidding defiance to the attacks of privateers and row-boats.

The sponging and loading a long gun with the present

unwieldy staff is both a dangerous and difficult task, and not at the most favourable time to be accomplished without great danger of the men performing that duty being killed or wounded, owing to extending their bodies out of the port-hole to enable them to manage the staff. It is also difficult to load a gun when fighting, on the lee side of a low vessel, or on the lower deck of a line of battle ship; at such times, should the rammer-head be entered in the gun, and the ship roll, the sponge is unavoidably plunged into the sea; and if the staff escape being broken, it is rendered useless until the sponge is washed and wrung, and the gun is then to be sponged with a wet sponge, which is often a dangerous experiment, nor is there any means to put on a clean one; many staffs are broken, when plunged into the sea, from the velocity of a ship through the water, and many are also dragged out of the men's hands and totally lost.

In running out a gun by the side tackles, it seldom occurs when it is out, that it points to the object, owing to its not being possible to equalize the exertions of the men at the two tackles, and from the pitching motion of the ship throwing the gun out of its place; the crow-bar and hand-spike are then to be resorted to, to train it, which operation necessarily occupies much time, and often, while performing, the opportunity of firing is altogether lost. Much time is also spent in coiling down the side-tackle-falls, which at all times requires great attention, and much caution when the guns are fired, to prevent the men from entangling their legs, by which many, unaccustomed to a battle, are thus wounded, as also by the staffs being thrown about by the falls when they become entangled together.

By my improved mode, two or four men run a gun out of the port-hole, according to its calibre; and in case of emergency, in small vessels, one man can accomplish this. When a gun is running out, the man holding the trigger-line guides it by the handspike, or other lever, at once to the object, and it is by him instantly fired, without the loss

of time in coiling down the side-tackles, the necessary attention to the breeching, and to training the gun.

The breeching checks the gun in its recoil, so that no strain is either upon the axle or rope by which it is run out; and that no accident may occur to the mechanism, when the gun is fired, it is so constructed as to be thrown out of gear at that time. If it should be shot away or broken, any person having a hammer, a spare axle and wheels, can complete the whole; and this accident cannot occur unless a shot passes through the sill of the port and breast-piece of the carriage: such a shot is as likely to disable the guns upon the present as the improved plan.

The improved staff answers the purpose of the four now in use; the one made for experiment for a nine-pounder long gun was of five-eighths round bar iron, nine feet of which weighed nine pounds: this size, though tapered from the centre to the ends, is sufficient to load a thirty-two pounder; the tapering reduces its weight to seven pounds, but the staff may be hollow from the joint to the screw ends. As regards the weight, it would be immaterial were it twice as heavy as those in present use; because, from its construction, its leverage is so much less. The improved staff is jointed in the centre, and has screw-ends for fixing on the sponge, the worm, ladle, &c. This enables the men at every gun to have the whole of their implements at hand without lumbering the decks, and on no occasion to wait one for another, as is now the case; and if loading a gun upon a lower deck or in a low vessel (particularly on the lee side, when rolling), the sponge-head, from the staff being jointed in the centre, can be turned upwards, to prevent it from either dipping into the sea, being broken, or forced out of a man's hand; and there being no lever upon the man, he continues the operation of loading, which he could not do at such times with the long wooden staff. Again, should the sponge become foul or wet, a clean one can be put on at pleasure; and if a jointed wooden staff, after the proposed plan, be

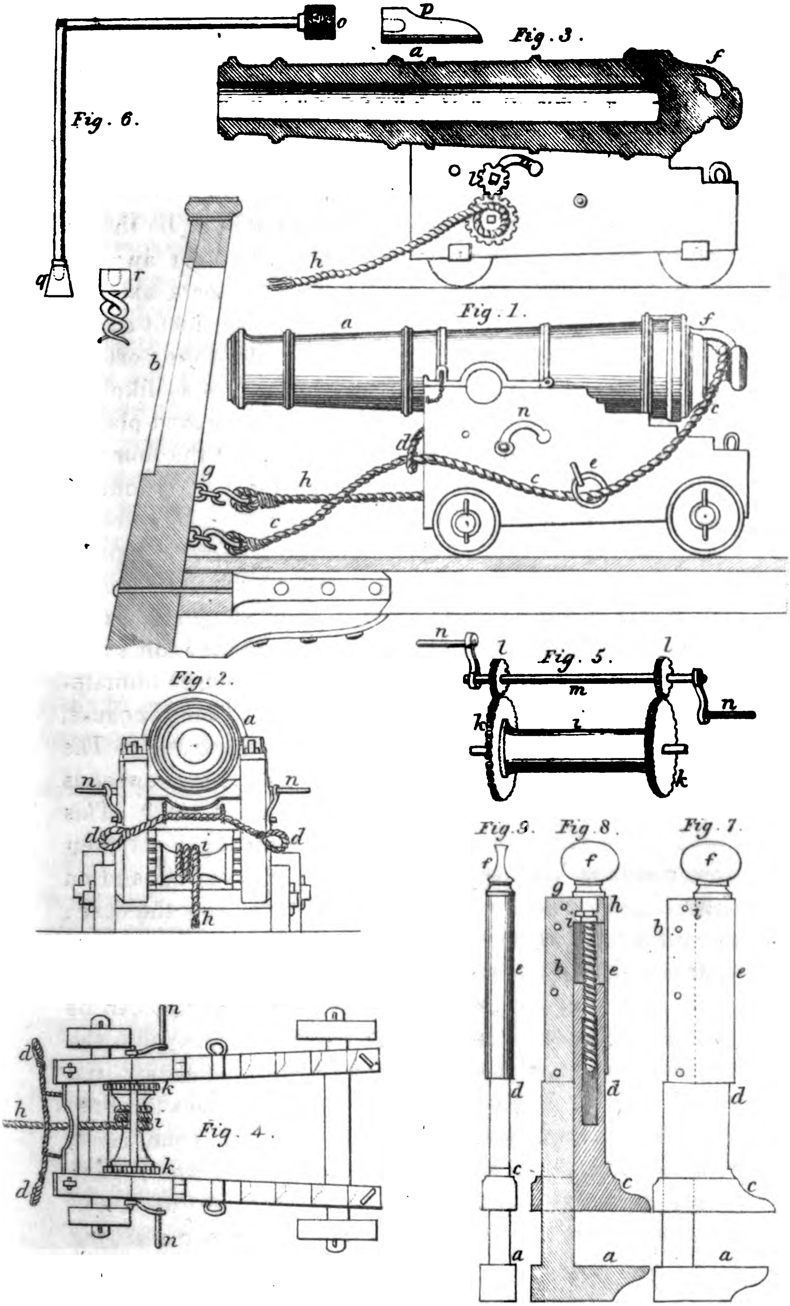


Fig. 3.
Fig. 6.
Fig. 1.
Fig. 5.
Fig. 2.
Fig. 9.
Fig. 8.
Fig. 7.
Fig. 4.

adopted, very considerable expense will be saved, as any piece of wood will then answer the purpose. By the present mode of warfare, the cartridge is flannel; and if paper be used, a flannel bottom is put to the cartridge, which prevents the necessity of worming so often as was formerly the case; but if any deem it expedient to worm a gun frequently, a spring wad-hook may be fitted in the sponge-head, so that the gun will be wormed every time it is loaded.

With the improved staff, the man loading has no necessity at any time to expose his body outside the port-hole, as is now the case, as he can, with one hand extended, easily perform this operation, which his whole exertion could not at such a time accomplish with the present staff.

The improved staff is considerably shorter than those at present in use,—can be speedily turned under the port outside,—also on the inside under the deck,—is handed in and out of the port-hole with the same pliability and facility as a rope one,—consequently one half the time is gained by this in loading a gun. With one of the improved staffs to each gun, and a few spare ones to each deck, the many now in use will be rendered unnecessary.

Reference to the figures of Lieut. Green's improved gun-carriage and ramrod. Plate III.

Fig. 1. A lateral elevation of the cannon, mounted on its carriage. Fig. 2. A front elevation of ditto. Fig. 3. A section of ditto. Fig. 4. A bird's-eye view of the carriage, the gun being dismounted. *a*. The gun. *b*, fig. 1. The port-hole.

ccc, fig. 1. The breeching, secured at one end to a strong eye-bolt driven into the ship's side, then passing through one of the loops in the breast rope, *d*, through the ring, *e*, on the side of the carriage, and the loop, *f*, at the breech of the gun, whence it passes on the other side of the gun through the other carriage ring, through the other loop in the breast rope, and is finally secured to a

strong eye-bolt like the former, fixed on the other side of the port-hole.

g, fig. 1, is an eye-bolt into which is hooked the rope, *h*, figs. 1, 2, 3, 4, which passes round the axle *i*, figs. 2, 4, 5. This axle is toothed at each extremity, as shown more plainly, fig. 5.

l l, fig. 5. Two pinions fixed on the axle, *m*, take into the teeth of the axle, *i*, and by means of the power of one or two men applied at each of the winches, *n*, *n*, figs. 1, 3, and 4, wind up the rope, *h*, and thus bring the gun to the mouth of the port. When this has been done, the axle, *m*, is to be thrown out of gear by being raised from the bottom of the curved hole, *m*, figs. 1 and 3, to the upper extremity of the same, and the winches are to be taken off. The gun being then fixed, unwinds in its recoil the rope on the axle, *i*, and is finally stopped by the resistance of the breeching; the winches are then fixed on the axle, *m*, and the axle is again brought into gear in readiness for winding the gun to the mouth of the port as soon as it has again been charged.

Fig. 6. A jointed rammer, made of wood or of bar iron, either hollow or solid. The ends, *o* and *q*, may be unscrewed and replaced by the screw, *r*, or the scoop, *p*.

Description of an improved screw-wrench, invented by Mr. Thomas Eddy, 354, *Oxford-street.*

From the Transactions of the Society of Arts, &c. Vol. XLII.

The silver Vulcan medal of the Society was voted to Mr. Eddy for this invention.

WITH AN ENGRAVING.

This screw wrench is actuated by a screw, as that is which is in common use, but differs from this latter in the screw being introduced into the sliding part instead of into the handle. By this arrangement the instrument is rendered much stronger, and is not liable to open and shut

by the turn of the hand while using it, as is the case with the common one.

In manufactories where the work is heavy, the common wrench is often breaking in the screw, an accident which cannot occur with the new one, as the strain is not on that part which contains the screw. It may be made at nearly the same expence as the one in common use.

Reference to the engraving of Mr. Eddy's screw-wrench. Plate III.

Fig. 7 is a side view. Fig. 9 is an edge view. Fig. 8 is a longitudinal section.

(The same letters refer to the same parts in all the figures.)

a is the fixed chap, *b* is the fixed bar, *c* is the moveable chap which passes through and slides upon the bar, *b*; *d* the moveable bar fixed to the chap, *c*. This bar has a hollow barrel screwed at its orifice, in which the solid thumb-screw, *f*, works.

At the extremity of the bar, *b*, is formed a shoulder, on which rests the square piece, *g*; or the bar may be turned up at right angles, forming a short projecting leg, which will answer the purpose of the piece, *g*, and will be both stronger and cheaper. A square hole is to be made in *g*, to admit the screw, *f*, and this hole is to be contracted in one part by the insertion of two square pins, *i* and *h*, which confine the neck of the screw so as to allow it to turn round, but not to move backwards or forwards: *e* is a plate of iron, wrapped round the end of the instrument in order to keep the parts in their proper places, and to prevent the screws from being choked with dirt.

Hence it is obvious, that when the screw, *f*, is turned in one direction, the barrel, *d*, with the chap, *c*, is pushed towards the chap, *a*, and that it is withdrawn when the screw is turned in the opposite direction.

NOTICES OF NEW PATENTS.

The number of patents having greatly increased since the commencement of the Repertory in the year 1794, it has become impossible to publish the specifications within any moderate period; even the most important of them, which was the original intention and aim of the proprietors of the Work: they have therefore determined, on the commencement of the present Volume and New Series, to give an account in an abridged form, accompanied occasionally by remarks, of every new patent, as soon as the specifications shall be enrolled, or as speedily as circumstances will permit, with the view of gratifying the immediate curiosity of the readers of the Repertory, and afterwards to print the specifications of such patents as, from the intrinsic value of the inventions, their extensive use, or other attractions, shall have become objects of public attention and general interest.

In the selection of specifications for subsequent publication, the Editors will always be happy to attend to the suggestions and wishes of the constant readers of the Work; and they take this opportunity particularly to invite patentees to favor them with the loan of their specifications, or accurate copies of them, at their earliest convenience.

Patent granted to JOHN VALLANCE, *of Brighton, Esq. for producing locomotion by stationary engines.* Dated Feb. 19, 1824.

Abstracted from a pamphlet published by the Patentee.

To produce locomotion, or the transport of persons and merchandize from one place to another, by stationary engines, Mr. Vallance proposes to form an arched tunnel, or hollow cylindrical passage, between the places, at the two ends of which are to be placed exhausting engines, worked by steam, or other power, to draw the air from that end of the passage to which it is required to effect the conveyance, and thereby cause a strong draft of air through it from the opposite extremity. The carriages for this purpose are to run on a rail-road within the tunnel, and to have in their front a vertical plane nearly fitting the passage, and capable of being turned either at right

angles to its direction, or in the same line with it, as required, or some similar contrivance, for regulating the impulse of the air.

Suppose two places, A and B, ten miles asunder, have a tunnel of this sort placed between them, the loaded carriage being put in on the rail-road at A, and the exhausting engine at the other end of the tunnel at B, being set to work, on a signal being made for that purpose, and the vertical plane of the carriage being placed across the passage, the act of exhaustion of the air will, soon after it commences, cause the pressure of the atmosphere to act on the opposite side of the plane in proportion to its progress, and will thus impel the carriage towards the other end where the engine works with a velocity proportionate to the excess of the pressure over the resistance. In this plan it is evident that the pressure of the air between the vertical plane and A, will be, in all parts, very nearly the same as that of the atmosphere, and that the pressure between it and B need not be diminished, in order to produce a very considerable impulse, more than the difference indicated, between settled fair and much rain, by the barometer, as observed by the patentee, in the pamphlet which he has published, to say nothing of that which exists between the atmospheric pressure at the level with the sea and that on lofty habitable mountains, or that which has been borne without inconvenience under diving bells; and, indeed, had it not been for the carelessness of the editors of some periodical works, who gave the plan of Mr. Vallance the very erroneous appellation of "travelling in vacuo," (though we believe without the smallest ill-will to it,) the mistakes which have taken place on this point would probably never have occurred, and Mr. Vallance, and his readers, been spared the laborious confutation of this chimera in his pamphlet.

The patentee has been also at great pains, in his pamphlet, to prove that his tunnel may be made sufficiently air-tight for the purpose; a point which no one

could doubt who has known of the works of a similar nature, which are made water-tight, which is more troublesome to effect; indeed, so little difficulty does there appear in making the tunnel impervious to air, that we think the author's project of making bricks of a peculiar shape and fabric for its construction, or what he denominates "burnt clay (not bricks) shaped for the purpose," will be found unnecessary; and that common bricks and mortar will be found very sufficient for it, and that by covering it with earth, which it will be advisable to do for other reasons that shall be mentioned, it can be still farther secured, in this respect, at a cheap rate; and that, moreover, by pudling this earth, in the manner done to make canals water-tight, an additional resource remains for means to exclude the air, if desired. The chief nicety in fabricating the tunnel would probably consist in making it very even inside, and exactly shaped to the same section throughout; and it would be necessary to plaster or stucco it smoothly for this purpose, so that the transverse plane attached to the carriage moving in it, might be made to fit it more closely, and have as little space as possible left between its edges and the inside of the tunnel.

The patentee, in stating the power of atmospheric pressure in conveying goods and passengers in this method, very needlessly incumbers himself with the merits of Mr. Palmer's rail-road, in the praises of which he is profuse, and with those of Mr. Brown's vacuum engine. (See Repertory of Arts, vol. XLV). So far from agreeing with him as to the first, we really are at a loss to conceive any point in which Mr. Palmer's plan excels the common projecting rail-road, it being subject to the same friction of hollow-edged wheels moving on bars or rails; (the grand defect of all plans for rail-roads, hitherto brought forward, being in the friction of the sides of the wheels against the rails, and being, in rail-roads of the description mentioned, only somewhat less than in tram-roads;) and besides, we think Mr. Palmer's rail-road would be very expensive,

from the cost of the pillars to support the rail which it would require, and difficult to keep in order, from the liability of these pillars to be forced sideways out of a vertical position, as well as to sink at their foundations, from the pressure: but if Mr. Vallance can make good his opinion on this point, by real proof, we shall be very willing to allow him the full advantage of it in increasing the power of his project; but till then he must be content with being granted the 100 pound load, which he first claims for every pound of impulse on his transverse plane, as we cannot spare him the other 200, that he desires, on base assertion. However, the 100 pounds will do very well for him, and ought to content any moderate speculator; since, on the tunnel-road that he proposes, of 11 feet and a fraction diameter, or 100 square feet in area, the moderate pressure, easily procured, of two pounds on an inch, would produce a force equal to 12 tons 17 cwt. on his transverse plane; which, multiplied by the 100 lbs. which we allow, will give him a load of 1210½ tons, to be transported by this impulse; a weight so great as almost to stagger our faith! and which we must qualify by claiming for it the due proportion of wheels, at least one to every 1300 pounds of the load, and those truely set and turned, on well-formed axles properly oiled, and moving on a rail-road without any ascent. As to Mr. Brown's engine, as the patentee somewhat recants in the appendix, we shall decline, at present, farther discussion on that subject.

The next matter in importance to the great loads to be carried at once in the patentee's tunnel, is the velocity with which he thinks they can be moved through it. And here again we are sorry we must prune somewhat from his expectations; even granting that he could, as he asserts in his advertisement at the end of the pamphlet, transport a carriage at the rate of 60 miles an hour in a tunnel *one mile long*, it does not follow that he could do so in one 60 miles long, or even a sixth of the distance, and for a cause that

he is well aware of, as he has pointed out means of obviating its effects in one instance, which is the resistance to the passage of the air from the friction against the inside of the tunnel, and from the eddies which this will cause in its internal motion.

To convey air through long tubes has only been required in mines; and being mostly a point of curiosity hitherto, we do not know that the rate of the resistance to its motion in them has been yet determined in any precise manner. All we have yet seen on the subject is the account of the experiment of the late Mr. Wilkinson, the well-known ironmaster, (printed in the 8th vol. of the "Retrospect of Discoveries, &c." p. 60,) which the patentee notices; a paper on blowing machines, in the *Journal des Mines*, No. 152; and another, the title of which we cannot now recollect. But these documents are relative to *forcing air* through pipes, which is very different from drawing it out from them, as the author observes; but still we may extract some inference from them; for if Mr. Wilkinson found it impossible to force air through pipes 5000 feet long, and one foot in diameter, by the power of his water-wheel, or indeed farther than 600 feet in any sensible degree, we must conclude, fairly, that atmospheric pressure, by which the extracted air is to be replaced, and which is to give the operating impulse to the author's carriages, will also have its limits, and the moving forward much quicker than the compressed air. Yet we cannot suppose that it possesses any magic power, to enable it to pass instantaneously through obstacles which resist compressed air altogether. The same resistance from friction against the inside of the tunnel, that the air experiences in entering, will also operate to retard its passage outwards to the exhausting engine; and it will be delayed, probably, most of all, in the first instance, by the limited powers of the exhausting apparatus; which, granting all the expedients for the purpose to exist which the patentee hints at, must still be on an enormously expensive scale, to exhaust air, at

the rate of 60 miles an hour, from a tunnel 10 feet square in area, as he proposes, which would not be less, in one minute, than 52,800 cubic feet, or 319,994 gallons. Here then we must make some reductions: to bring down the velocity to a tenth of this, or six miles an hour, with a tunnel of this size, will still, we fear, leave the apparatus too expensive. Let us then suppose the tunnel reduced to an area of 30 square feet, or six feet and a fraction in diameter, (which is the smallest size that would allow of a carriage with passengers to pass through it with any convenience,) the exhaustion necessary for a velocity of six miles an hour, would then be 9,696 gallons in a minute. This would come within compass, perhaps, especially as we are aware there are means for drawing off the air from the tunnel, without metallic air-pumps or cylinders, which are objectionable both from their friction and cost, or without the application of Mr. Brown's vacuum engine, as proposed by Mr. Vallance.

We have now been obliged to lower the patentee's calculations a good deal of the powers of his invention; but even on the last scale mentioned, its effects would be very great, being able to transmit 363 tons, by the pressure of two pounds on a square inch, in an area of 30 feet, or that of a tunnel about six feet in diameter.

There is one point more in which the tunnel road would be inferior to a common rail road, and of which, though very obvious, the patentee takes no notice; which is, that in the tunnel road but one set of carriages could pass through it at the same time. If, for example, the tunnel were 60 miles long, the goods and passengers entered at one end at the same time, must fairly pass through the whole 60 miles before a second load could be put in motion in it to any useful purpose; while, on a common rail-road, as many carriages may be moved at once as can be placed on it; nor does there seem any way of diminishing this difficulty, but by making short stages in the tunnel, with an exhausting engine for each: but even with this disadvan-

tage, it would form a most powerful apparatus for the conveyance of merchandize; since, in stations suppose of 12 miles asunder, with exhausting engines capable of causing the load to move six miles in an hour, in a tunnel of the dimensions last mentioned, twelve times 360 tons might be transmitted 144 miles in 24 hours: a quantity so great, and so much beyond the wants of any traffic existing between any two places in England, that it may be diminished very much by putting the stations farther asunder, and using less powerful engines, which would proportionably lessen the expense, and enough force be still left for any purpose that can be required. And even with these reductions the power of the apparatus, as thus fairly calculated, will seem chimerical to some; what then will they think of the assertion, that its power may be easily doubled, by having engines capable of exhausting the air quick enough to cause a pressure of four pounds on each square inch of a plane placed across the tunnel, which is certainly as possible as to produce the pressure before stated.

Having mentioned the points wherein we differ from Mr. Vallance, we think it fair to state some of the advantages of his plan not yet noticed. The first is, that the most severe fall of snow, which would render all common rail-roads useless for the time, could have no injurious effect on the traffic by his tunnel, or stop it for an hour; and the next, which has escaped the patentee himself, is, that in a great proportion of the length of the tunnel, the ground through which it passed could be made as useful for agricultural purposes as before, as the tunnel could be sunk beneath the surface, or covered with earth sufficiently for grass crops in most cases, which would, at least, form a drawback against the cost of the land, in proportion to the rent the ground above the tunnel would produce.

The patentee, in the first part of his pamphlet, has clearly shown the fallacy of the expectations which have been raised, of the prodigious velocity with which carriages

could be moved on common rail-roads; the great danger of their running off the rails, and being upset, when moved very rapidly, and the extreme risk of life, which must arise from the high-pressure steam engines necessary for them. He has also proved the great inferiority of locomotive steam engines to those which are stationary, in the work which they can perform for a given quantity of fuel, as well as in other respects; showing, that the consumption of coals is in general five times greater in the locomotive engines for the same horse powers, and in some cases much more, when compared with a few particular stationary engines of superior performance; which, added to the locomotive engines having to move their own weight, which seldom is so little as five tons, in addition to that of the articles to be transported, gives stationary engines a decided superiority where they can be used for the propelling carriages, which they certainly may in the author's air tunnels. We must however wait for another opportunity to resume this part of the subject, which, with some other matters relative to it, we hope to notice in a future number, having already exceeded the limits proper for this paper, and within which we hoped to have stated the whole of what we had to observe relative to an invention which we think extremely ingenious, and, in fact, the best for the purpose yet made public; which purpose we consider of extreme importance to the mercantile interest of England.

In lowering the calculations of the powers of the author's contrivance to something of a human standard, we trust we may have benefitted both him and the public; since a good thing may be neglected by being introduced with pretensions so prodigious, as to exceed the belief of all moderate men; and we will now conclude with our best wishes for the patentee's success in his very useful undertaking; assuring him, that should it be found, on trial, to exceed the powers of our estimation, we will not the less rejoice at the benefit this must be to our country, and be glad to give the fact every publicity in our power.

Patent granted to Mr. William Shalders, *of Norwich, for a gravitating expressing fountain, for raising and conveying water or any other fluid.* Dated April 12, 1825.

Mr. Shalders' engine is a species of forcing pump, formed by a buoyant plunger, working up and down in a vessel of suitable capacity, through the intervals between which plunger and vessel the liquor is prevented from passing by a leather cylinder (or bottomless bag), the lower part of which is fastened securely to the vessel, and the upper part to the plunger, so that the joinings may be water-tight. There is, besides, another hollow cylinder, of wood or metal, whose lower part is fastened water-tight to the top of the containing vessel, and whose top rises high enough above it to hold within it the leather bag, at its greatest elevation, and whose capacity is sufficient to admit of the passage of the leather bag up and down between it and the plunger without friction. Into this apparatus a tube enters at its lowest extremity, to admit the water or liquor, furnished with a valve to prevent its passing back again; and from the same part another tube passes upwards, having a similar valve to prevent the liquor from returning down into the vessel, and whose purpose is, of course, to convey the liquor to the height and distance required.

Two of these vessels are represented in the drawing and specification, connected together, to be worked alternately in a reversed direction, and with the two eduction pipes joined into one, for the purpose of producing a constant uninterrupted stream of the liquor.

When the source of water is by any means as high as the vessel that contains the plunger, this latter, being made lighter than water, will of course be buoyed up in proportion as this difference of gravity takes place, which the patentee thinks an advantage: and will also be forced up by the hydrostatic pressure in proportion as the source is higher than the top of this vessel.

The patentee does not restrict the materials of the vessels or plunger to any peculiar matter or combination; and

the drawing shows a frame-work, above the apparatus, through which the plunger rod passes, so as to work up and down steadily, without pressing the connecting leather against the sides of the vessels.

The drawings represent the vessels and plunger as being made of coopers' ware, which, though it may be cheap, is certainly too liable to derangement to be as advisable as other materials within the limits of the specification. We also think the leather bag (or connector) would work easier and last longer, if furnished with some internal hoops, with bands between them outside, in the manner of the cylindrical bellows, or the still older instrument—the French hair-powder puff.

Patent granted to Mr. CHARLES ANTHONY DEANE, *of Deptford, for an apparatus to be worn by persons entering rooms filled with smoke or other vapour, for the purpose of extinguishing fire, or extricating persons or property.* Dated Nov. 20, 1823.

Mr. Deane's apparatus is composed of a copper helmet or head covering, with a garment attached to it of some substance not easily set on fire. The back of the helmet is made double, and to the lower part of it a long tube of leather is fastened, by which fresh air from without may be conveyed to the wearer by a double bellows, placed for that purpose in a box outside the building. The air that enters the hollow part at the back of the helmet is distributed by several passages, two of which open near the apertures for the eyes, in order to keep the breath from condensing on the glass with which they are covered, and obscuring them; the glass is also protected by a small grating outside. Opposite the mouth a circular revolving valve is placed, similar to those used for air regulators in some of Rumford's stoves, which may be opened or closed according as the button in front is turned. When it is closed, all communication with the room and the mouth of the wearer is closed, and he then alone inhales the air supplied by the pipe, while his breath passes off as respired

along with the current of air from the bellows, by another pipe, that descends from the helmet to his foot, to which it is secured by a strap, to keep it in a proper position.

To prevent the air-pipe being closed by a beam or bricks falling on it, or any other accident, a rope is passed through its whole length to keep it open.

The person entering a room full of smoke, after fastening on the helmet and dress described, by straps, so placed as to prevent the entrance of any vapours from without, and tying a lighted lanthorn to his breast to direct his steps, and taking with him proper implements for breaking open doors or other obstructions, closes the valve opposite his mouth as soon as he finds any inconvenience from the smoke, first giving notice to his assistant without to work the bellows; after which, he breathes solely the air supplied by the pipe.

The box in which the bellows is placed is so contrived, that the helmet, dress, pipes, and whole apparatus may be easily packed up in it together, to facilitate their transportation.

By this apparatus, the patentee asserts, that a person may breathe with facility in a place so full of smoke or other vapour as to suffocate him without its assistance, and be enabled, in this dangerous situation, to remain sufficiently long to remove property of value, and in many cases to save the lives of persons in houses on fire, who would otherwise fall a prey to this awful element.

The Society for the encouragement of Arts, &c. on the 30th of May last gave a premium of fifty guineas, and the large silver medal, to Mr. J. Roberts, of St. Helen's, Lancashire, for an apparatus for enabling persons to breathe in air loaded with smoke and other suffocating vapours, which, as far as we can learn of it, is extremely similar to that of the patentee, Mr. Deane, the patent for which was sealed eighteen months previous to the meeting of the Society in which they gave the above premium for the apparatus of Mr. Roberts.

Patent granted to Mr. Edward Schmidt Swaine, *of Bucklersbury, London, for a communication made to him by Frederick Adolphus Augustus Streeve, of Dresden, M.D. and Edward Swaine, of Leipsig, merchant, for a method of producing and preserving artificial mineral waters, and for machinery to effect the same.* Dated 9th October, 1823.

The principal instance given in this specification of the general purpose of this patent, is the mode of making artificial Seltzer water, by impregnating common water with carbonic acid gas.

The apparatus for this process consists of a vessel of lead, into which the patentee introduces the materials from which the gas is to be produced by the action of sulphuric acid (among which materials, by some strange error, he mentions lime-water and lime). At the top of this lead vessel is fixed a funnel, communicating with it by a pipe, closed by a lead stopper, for holding the sulphuric acid, which passes into the lower vessel on raising the stopper. A bent pipe proceeds from the top of the lead vessel downwards, to the lower part of another closed vessel, containing a solution of barytes (to purify the gas from sulphurous acid gas) from whence another pipe conveys it to a gas holder, formed in the common method. From the holder the gas passes to a gasometer, made on Mr. Clegg's principles, whence, after passing through its revolving chambers, and having its quantity registered by the counting apparatus, it is drawn through a pipe into an air-pump, fixed in a horizontal position, and worked by a revolving crank and fly-wheel. Above the pump are placed two small chambers, which communicate with its different ends; into one of these the gas is forced by the pump, on its way to the impregnating vessel, and the other holds water only, for acting against the back of the piston to diminish the friction. To the pipe, which goes from this part of the apparatus, is joined a barometer, whose index shows the pressure acting on the gas. Over the impregnating vessel, into which the gas next enters, and which

is filled with pure water, there are two small chambers fixed, from which pipes pass to it, and whose office is to hold any fluid compound intended to give flavour to the impregnated water. From the impregnating vessel a pipe passes downwards for filling the bottles, whose extremity is made conical, and covered with a collar of leather, against which the mouth of the bottle to be filled is pressed upwards by a treadle, moved by the foot of the person who fills it. When each bottle is filled, it is instantly corked, and the cork secured by a piece of wire bound over it.

Besides what we have described, the apparatus is furnished with valves and cocks in the usual places, and has also two agitators, one placed in the lead vessel that holds the materials, formed like those used in revolving churns, and turned round by an axle that passes through an air-tight collar at the top of the vessel; and another in the impregnating vessel, formed in a similar manner.

The only thing that appears to us like novelty in this apparatus, is the introduction of the gas-meter, and perhaps the flavouring vessels at the top of the impregnating vessel. We should indeed add to this list the extracting carbonic acid gas from "lime and lime-water," as directed by the patentee, which, from their very nature, cannot contain any of it!!!

Patent granted to Jean Henry Petitpierre, *of Charlton-street, Somers'-town, engineer, for a machine for making, from one piece of leather, without any seam, shoes, slippers, gloves, caps, hats, cartridge boxes, scabbards, and sheaths for swords, bayonets, and knives.* Dated March 20, 1824.

In order to make a slipper in this method, a piece of thick side leather is cut out in a particular shape (somewhat similar to that which a slipper would assume if the upper leather were pressed down flat upon the sole); a groove is made across this about the length of the intended upper leather from the toe; and of the depth of half the

thickness; the piece is then fastened down by screw clamps, on a table prepared for the purpose, having the heel part first bent down at the groove, so as to be out of the way. It is now ready for being split or divided by a knife or tool, which is fixed into a frame, having such guides and stops fastened to it (particularly a projecting pin that moves in a slit in the table), that it can only be moved back and forwards to a certain extent, with a very limited lateral motion, and at a precise level above the table, so as in no case to cut lower or higher into the fixed piece of leather than intended.

The hollow of the toe part being formed in this manner, the position of the leather on the table is reversed, and the hollow of the heel part cut by a similar operation. This is the simplest way in which a slipper can be formed by this method, and therefore the best for giving an idea of the mode of proceeding. But as by it the sole would not be left thicker than the sides of the upper leather, in order to obviate this defect, and leave the sole in a proper degree thicker than the upper, the piece of leather must be first cut out in the form before described, which a slipper would assume if pressed down flat at the top. Then this piece must be cut externally at the edges first, by the instrument, at half its thickness from the bottom, and as far in as to the outline of the sole, which is ascertained by having a piece, of the shape of the sole, fastened down upon it by the clamps that secure it to the table. After this it is to be turned down at the groove (cut across as before mentioned), and have the inside of the toe part, and of the heel part, cut open inside by the instrument, at a third of the thickness of the whole piece from the top, in the same manner as first described, by which means the sole will be left of double the thickness of the upper, but projecting at each side beyond its proper shape. The piece being now pulled open, and forced upon a last, after first wetting it, is to have the superfluous parts of the sole pared off, and to be rubbed down by a smooth tool till it

assume the form of the foot. It may be then curried and dressed, coloured, and finished as desired.

Gloves, caps, hats, cartridge boxes, scabbards, sheaths of all kinds, and many other articles, may be formed, in this manner, from thick leather, without any seams, by having moulds of fit shape, and knives so constructed, and furnished with such guides and guards, as are most suitable to the article designed.

Besides the saving of workmanship in this method, there would arise a further economy in the quality of the leather, since, according to the prices current, sole leather, by the pound, is in general not more than half the price of upper leather, or calf skins.

That it would succeed well for slippers, and most of the other articles mentioned, seems very probable; but we have great doubts that shoes could be made in this way sufficiently even in the grain of the uppers in all parts, to produce the neatness required for their appearance, as the parts of them cut from the centre of the thick leather must necessarily be more open and spongy than its external surface: and the top of the shoe would thus have quite a different look from the sides, and could never be made to take the same degree of polish in being cleaned.

Another objection to shoes of this kind is, that they could not be mended but in very few cases, without totally disfiguring their appearance, which in shoes, whose chief advantage must be economy, would form a very material drawback.

Patent granted to Mr. John Leigh Bradbury, *of Manchester, for a new mode of twisting, spinning, or throwing silk, cotton, wool, linen, or other threads, or fibrous substances.* Dated 3d July, 1824.

Mr. Bradbury's specification embraces two objects principally: the first being an improvement in the method of performing the operations stated in the title, for which he obtained a patent in 1816; and the second being the

application of the machine used commonly in the cotton manufacture, called the mule, to the twisting and throwing of silk.

The first invention, or improvement, consists in causing any pair of delivering rollers in a spinning machine, to cease from turning as soon as the thread breaks that proceeds from them; which is effected by causing the thread, on its way to the bobbin, to pass through an eye in the top of the longer arm of a lever turning on a pivot, which remains horizontal as long as the thread presses on it, in its passage; but as soon as the thread breaks, it rises upright instantly by the action of the short arm of the lever, which is weighted accordingly for this purpose. This short arm, in coming thus to a vertical position, comes in contact with pieces that project from an axis constantly turning round beneath it, and that is placed there horizontally, and at right angles to the plane in which the lever moves. On thus coming in contact with the power of this axis, the short arm is pressed forward, and the long arm of the lever thereby being forced back proportionably, causes an inclined plane attached to it to push back the standard on which one of the rollers is supported, so that the wheel that connects it with the general machinery shall be out of gear, as it is called, and its action on the thread entirely cease, until the lever is again brought to its horizontal position, and kept so by the thread, after its being mended, and laid on it again.

The application of the mule to silk spinning, which is the second object of the patent, consists merely in substituting bobbins of silk for cops of cotton, in the number proportioned for each spindle, according to the thickness of the twist required; and then proceeding with the machine, as in spinning cotton, to give the proper degree of twist, and roll the silk up on the spindles.

In the drawings of this machine, the spindles seem to be inclined forward more than usual, being, in this instance, in an angle of 45° with the horizon.

Patent granted to WILLIAM AINSWORTH JUMP, *of Middlewich, and* WILLIAM COURT, *of Manor Hall, Cheshire, Esquires, for an improved method of manufacturing salt.* Dated June 15, 1824.

THIS improvement in making salt is in the apparatus. The pan for boiling the brine is shallow, and of large surface, and, as represented in the drawing, has several fire-places beneath it; along the fore part of which, beneath the pan, there passes an iron pipe from a reservoir of brine, on a higher level, the further extremity of which rises up and turns over the upper edge of the pan. On opening a cock in this pipe the brine from the reservoir forces that in the pipe, heated by passing over the fires beneath the pan, to pass forward and fall into it in a boiling state, or nearly so, and therefore not liable to retard or stop the evaporation, as the introduction of cold brine does in the common method.

We have no doubt of its being advantageous to heat the brine before it is introduced into the pan, but are inclined to think that the method practised for this purpose at the manufacture for making Cheltenham salts, and elsewhere (which consists in warming it by the heat of the smoke that *has passed* the evaporating pan), is preferable to any method which intercepts the heat of the fires from the pan; and think also that pipes, placed as described, would soon be stopped up, or be burnt out, from concretions of earthy matter from the magnesian, calcareous, and other earthy salts, which always accompany brine of common salt, and which have a strong attraction for heated metal, as salt-makers well know, to their great detriment.

We much commend the plan of numerous fire-places, of smaller dimensions, under large boilers, in preference to one or more of great size, which the patentees have adopted, though hardly noticed by them in the specification; as this arrangement of the fires prevents the destruction of the fire bars, and the vitrification of the burnt coal, called

clinking, which takes place in large fire-places in proportion, more or less, to their size, both of which are troublesome and expensive, particularly the latter, which wastes much fuel, and rapidly wears out the fire-places.

Patent granted to Benjamin Rotch, *of Furnival's Inn, London, Esq. for an improved fid for the upper part of ships and other vessels.* Dated Aug. 21, 1823.

We are induced to notice this invention from the interest it has created from its presumed merit, in consequence of the report that government has been prevailed upon to purchase a license of the patentee, at a very considerable sum, the truth of which we are, however, much inclined to doubt, as in our opinion the invention is not of much merit. It is, we consider, expensive and complicated, and not easily repaired at sea, requiring three men to unship and fix the fid and takle-falls or burtons, throws the whole weight of the top-mast on the tressel trees, loads the top with iron, and renders the vessel more liable to be struck with lightning. It is altogether not so efficient as Mr. Smart's contrivance for the same purpose, for which the Society of Arts presented that gentleman lately their gold Vulcan medal; an invention we think preferable to Mr. Rotch's, being of a simple and cheap construction, which any man who can use a hatchet can make and repair, requiring but one man and a handspike to unship and fix it again, throwing the weight of the top-mast on the lower mast, and adding nothing to the weight of the top or the risk of the ship. We shall, however, in our next number, give the specification of Mr. Rotch's patent, and an account of Mr. Smart's invention, in order that our readers may judge for themselves of the correctness of the preceding remarks.

LIST OF NEW PATENTS.

William Henry James, of Coburg Place, Winson Green, near Birmingham, engineer, for certain improvements in apparatus for diving under water, and which apparatus, or parts of which apparatus, are also applicable to other purposes.—Dated May 31, 1825.—Six months to enrol specification.

John Harvey Sadler, of Hoxton, Middlesex, machinist, for an improved power loom for the weaving of silk, cotton, linen, wool, flax, and hemp, and mixtures thereof.—Dated May 31, 1825.—Six months to enrol specification.

Joseph Frederick Ledsam, merchant, and Benjamin Cook, brass-founder, both of Birmingham, for improvements in the production and purification of coal gas, Dated May 31, 1825.—Six months to enrol specification.

Joseph Crowder, of New Radford, Nottingham, lace net manufacturer, for improvements on the Puslew bobbin net machine.—Dated May 31, 1825.—Six months to enrol specification.

Joseph Apsdin, of Leeds, bricklayer, for a method of making lime.—Dated June 7, 1825.—Two months to enrol specification.

Charles Powell, of Rockfield, Monmouthshire, gentleman, for an improved blowing machine.—Dated June 6, 1825.—Six months to enrol specification.

Alfred Bernon, of Leicester-square, London, merchant, for improvements in fulling mills, or machinery for fulling and washing woollen cloths, or such other fabrics as may require the process of fulling.—Communicated to him by a foreigner.—Dated June 7, 1825.—Six months to enrol specification.

Moses Poole, of Lincoln's Inn, London, gentleman,

for the preparation of certain substances for making candles, including a wick peculiarly constructed for that purpose. Communicated to him by a foreigner.—Dated June 9, 1825.—Six months to enrol specification.

JOHN BURRIDGE, of Nelson-square, Blackfriars-road, Surrey, merchant, for improvements in bricks, houses, or other materials, for the better ventilation of houses and other buildings.—Dated June 9, 1825.—Six months to enrol specification.

JOHN LINDSAY, of the island of Herme, near Guernsey, Esq. for improvements in the construction of horse and carriage ways of streets, turnpike and other roads, and an improvement or addition to wheels to be used thereon. Dated June 14, 1815.—Six months to enrol specification.

WILLIAM HENRY JAMES, of Coburg Place, Winson Green, near Birmingham, engineer, for improvements in the construction of boilers for steam-engines.—Dated June 14, 1825.—Six months to enrol specification.

JONATHAN DOWNTON, of Blackwall, London, shipwright, for improvements in water closets.—Dated June 18, 1825.—Six months to enrol specification.

WILLIAM MASON, of Castle-street East, Oxford-street, London, axletree manufacturer, for improvements on axletrees.—Dated June 18, 1825.—Six months to enrol specification.

CHARLES PHILLIPS, of Upnor, in the parish of Frindsbury, Kent, Esq. for improvements in the construction of a ship's compass.—Dated June 18, 1825.—Six months to enrol specification.

GEORGE ATKINS, of Drury-lane, Gent. and HENRY MARRIOTT, of Fleet-street, London, ironmonger, for improvements on, and additions to, stoves or grates.—Dated June 18, 1825.—Six months to enrol specification

EDWARD JORDAN, of Norwich, engineer, for a new mode of obtaining power applicable to machinery of dif-

ferent descriptions.—Dated June 18, 1825.—Six months to enrol specification.

JOHN THOMPSON, of Vincent-square, Westminster, and the London Steel Works, Thames Bank, Chelsea, and JOHN BARR, of Halesowen, near Birmingham, engineer, for improvements in producing steam applicable to steam engines, or other purposes.—Dated June 21, 1825.—Six months to enrol specification.

THOMAS NORTHINGTON the younger, and JOHN MULLINER, both of Manchester, small-ware manufacturers, for improvements in the loom, or machine, used for the purpose of weaving or manufacturing of tape, and such other articles to which the said loom, or machine, may be applicable.—Dated June 21, 1825.—Six months to enrol specification.

ROSS CORBETT, of Glasgow, merchant, for a new step, or steps, to ascend and descend from coaches, and other carriages.—Dated June 21, 1825.—Six months to enrol specification.

PHILIP BROOKES, of Shelton, in the Potteries, Staffordshire, engraver, for improvements in the preparation of a certain composition, and the application thereof, to the making of dies, moulds, or matrices, smooth surfaced, and various other useful articles.—Dated June 21, 1825.—Six months to enrol specification.

JOHN FREDERICK SMITH, of Dunston Hall, Chesterfield, Esq. for improvements in machinery for drawing, roving, spinning, and doubling cotton, wool, and other fibrous substances.—Dated June 21, 1825.—Six months to enrol specification.

THE REPERTORY OF PATENT INVENTIONS, &c.

No. II. AUGUST, 1825.

Specification of the Patent granted to Mr. James Surrey, *of Battersea, in the county of Surrey, Miller, for a new method of applying heat for the producing steam, and for various other purposes, whereby the expense of fuel will be lessened.* Dated September 4, 1823.

TO all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, the said James Surrey doth hereby declare, that the nature of his said invention, and the manner in which the same is to be performed, is described and ascertained in the following explanation thereof, that is to say:

The invention of the said James Surrey consists in bringing into use the heat extracted from coal in the burning and manufacture of coke, by applying the same for the production of steam, for steam engines and other purposes, in manner following, that is to say:—As many coke ovens as may be necessary by the heat thereof to insure the quantity of steam required, being erected in the usual or any other convenient way, let an artificial search be made in each as high as the coals, when charged; and run on the top of the artificial search, a rim or curb of iron, or other substance, of sufficient thickness to retain the heat extracted from the coal or coke. Then place in each of the said ovens one or more tubes or pipes of iron,

or other metal, either separate or connected together, on the top of the artificial search; one end of each of the said pipes or tubes to come out at the front of the oven, with a flange for cleansing, and the other end thereof to run out at the back or other convenient part of the oven, a sufficient space being left between the said two pipes or tubes, or elsewhere, as convenient, for the smoke, fire, or heat to escape, instead of coming out at the oven's mouth or stock; and if the ovens be sufficiently large to admit thereof without interfering with the burning of the coke, other pipes or tubes may be introduced in like manner, between the coke and the crown of the oven. And the several pipes or tubes above-mentioned must be made to communicate with the main reservoir or boiler of the engine, or other works. The main reservoir or boiler being charged in the usual way, and so as to keep the before-mentioned pipes or tubes always full of water, steam will be generated and pass to the main reservoir or boiler, for any purpose required. Care should be taken so to place the pipes or tubes in the ovens that the draft be not checked, and that they may be taken out at the front or back of the oven, if required; and the said pipes or tubes should be independent of the ovens, and be so placed that the spring of the ovens will be behind the same. The fire, in passing out of the ovens, may be directed through a flue, and which flue may be conveniently and most beneficially made by carrying over the crown of the oven a second crown or arch, of iron, brick, or other substance, capable of confining and retaining the heat; and such flue may be filled with other pipes or tubes, to be so placed as to receive the greatest possible action of the fire passing through the flue; and the last mentioned pipes and tubes being also made to communicate with the general reservoir or boiler, and being kept filled with water as before-mentioned, an additional quantity of steam will be generated by means of the same fire or heat, and without any additional consumption of fuel. If the flame of one oven should be

found insufficient to consume the smoke of the other, a damper or register may be used to stop the smoke from passing direct through the flue, and a communication made from one oven to the other, by means of a pipe or aperture; also with a damper or register, to take the smoke of either oven alternately through the other, when sufficiently hot to consume the same, thereby insuring a convenient method of consuming the whole of the smoke, and converting the same into heat or flame, to be used or applied as before-mentioned.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

The principle of this invention consists in the introduction of tubes into coke ovens, &c. for the purpose of generating steam, by which more than two-thirds of the present expence of fuel will be saved, as has been demonstrated at the Patentee's premises, York House, Battersea, where the process has been in actual operation in grinding corn for nearly the last twelve months, producing the most satisfactory results.

The peculiar advantage of this method is, that the coal, instead of being nearly all consumed, is converted into coke, of a quality equal to any that is used by maltsters, and other persons requiring the most pure and perfect article of that description.

The Patentee submits the accompanying statements of the saving that would accrue by the adoption of his patent, to any person at present consuming 1000 chaldron of coals per annum, in London. He is enabled to detail with precision as to the first calculation, which shows the amount or difference by the conversion into coke, and its attendant charges, assuming that 1500 chaldron of coals are used, but preserved and converted by his process, (instead of 1000 consumed and wasted at present,) and that these produce 1800 chaldron of coke, being the relative ascertained proportions.

The second calculation states the sum expended for 1000 chaldron of coals, on the system now in use among Water Companies, which would be saved by the application of his patent, deducting the above-mentioned difference lost on the coke.

The third calculation shows that the expence of the necessary additions to the works connected with the steam engine, would be reimbursed by the profits of the first year's saving; and a considerable surplus also remain, above the cost of the works in question; and the annual saving afterwards on every 1000 chaldron of coals now consumed, is shown by the last calculation to amount to 1270*l.* after allowing for wear and tear.

By an arrangement which the Patentee has made with the principal coke merchant in London, who is willing to supply the coal, and receive back the coke, at the relative fixed prices named in the statement, he is enabled to engage with the proprietors of large steam engines in London (where a constant power is required), to perform their work upon the basis and terms specified, or at about half their present expence, without making any alteration in their engines or boilers; or he will grant licences to work under his patents (in England, Scotland, and Ireland), at a sum per annum, or at a premium for the term of his patents. The apparatus can be applied to every steam engine or boiler now in use, either high or low pressure; at the same time acting as a complete smoke consumer.

The Patentee suggests the great advantage and saving that would accrue by the application of the patent in the working of iron mines, as the same expence of fuel which is incurred in raising the water and ore, will smelt the ore; whereas, by the present method, a large quantity of coal is entirely consumed in creating steam for the engine, without giving any return of coke; when by his plan the coals used for steam return their value in coke, which is ready on the spot for the future operations of smelting; and this saves the further quantity of coal which is necessary

under the present system for the purpose of producing coke.

The Patentee also suggests that considerable benefit would accrue to the proprietors and the public, by the adoption of Steam Power Coal and Coke Companies, in particular districts in the United Kingdom, by erecting the apparatus, and supplying steam power to individuals; and for which purpose he is willing to grant licences to trustees for the carrying such an object into effect; and for his remuneration will agree to receive a per centage only on the profits of the company, after they are paid the interest for their capital employed; or a certain sum for the exclusive privilege of any particular district.

DR.	STEAM ENGINE.						CR.
	£.	s.	d.		£.	s.	d.
To cost of 1500 chaldron of coals, at 38s. per chaldron, delivered at the water side	2850	0	0	By proceeds of coke, 1800 chaldron, at 28s. per chaldron..	2520	0	0
To coke burner add 2s. per chaldron..	150	0	0	By balance, loss in difference of coal and coke	530	0	0
To labour in removing coke	50	0	0				
	£3050	0	0		£3050	0	0
To loss in making coke	530	0	0	By gain in saving of coal, 1000 chaldron being at present used and lost, at 38s.	1900	0	0
To Balance saved ..	1370	0	0				
	£1900	0	0				
To five coke ovens will cost erecting	500	0	0	By brought down, balance saved as above............	1370	0	0
To pipes, will cost..	500	0	0				
To balance, or surplus saved first year ..	370	0	0				
	£1370	0	0		£1370	0	0

Dr.	All subsequent Years after the First.		Cr.
To wear and tear....	100 0 0		
To balance of annual saving, on every 1000 chaldron, of coals at present consumed	1270 0 0		
		By brought down as above	£1370 0 0
	£1370 0 0		

Specification of the Patent granted to David Gordon, *of Edinburgh, at present residing at Stranrear, Esq. for certain improvements in the construction of wheeled carriages.* Dated August 14, 1821.

WITH A PLATE.

TO all to whom these presents shall come, &c. *Now know ye*, that in compliance with the said proviso, I, the said David Gordon, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the drawings hereunto annexed, and the following description thereof, (that is to say): My invention of certain improvements in the construction of wheeled carriages consists, first, in placing each of the wheels of the carriage between two horizontal bars or rails, in such manner that the wheels may be supported or hung upon bearings or pivots, which pivots may be adapted to turn round in brasses or collars, fixed in the rails, extending on each side of the said wheels. By this arrangement each wheel is furnished with its own axis or axle, having pivots formed at both ends thereof, which turn round in fixed collars (in the same manner as the wheel of the ordinary wheelbarrow), being entirely independent of the other wheels belonging to the carriage. In order to render the application of my invention clear and intelligible, and to

enable persons conversant with such matters to put it in practice, I have hereunto annexed a sheet of drawings or plans, wherein fig. 1 (Pl. IV.) shows a plan of the framing, adapted for a cart or two wheeled carriage, upon my improved construction, with the body of the cart or carriage supposed to be removed, in order to explain my invention. Fig. 2 shows an elevation of the same. (Note—the same characters or letters of reference are used to denote corresponding parts upon both the figures.) A A represent the two main bars or rails of the frame of the carriage: they project in front sufficiently to form the shafts, and are kept parallel, and maintained at a proper distance asunder, by two cross pieces, B B, which extend in width beyond the side rails, A A, and serve to support the outermost rails, C C, in such manner as to form two oblong openings or frames, of sufficient width to receive the carriage wheels, D D; each of the wheels, D, is fixed upon a short separate axis or axle, having pivots formed at each end; the outer pivots of the said axes or axles turn in collars, which are attached to the rails, C C; and the inner pivots turn in collars, attached to the rails, A A. The collars may be placed either on the under or the upper sides of the rails, or through the middle thereof, as may be found best; but I should recommend their being fixed on the under sides of the rails, as represented in the figure, with screw bolts passing through the rails, to retain them in their respective situations, and tighten them as they wear away; the bearings may be supplied with oil by pouring it in through a small hole from the upper side of the rails, which holes should be covered by a turning plate or cap, to prevent any dust from penetrating to the pivot: in like manner the pivots should not pass quite through the collars, so as to expose their ends, but should be rendered somewhat convex at their ends, to bear against the bottom of the cavity in the collars, in order to support any shocks endways which the wheels might receive in passing over rough roads: E E

represent two iron bars, extending from the rails, c c, to the shafts, in order to strengthen the frame, and prevent the ends of the rails, c c, from entangling with other carriages in passing; otherwise inclined pieces of wood might be substituted for the iron bars, as may be found most convenient: F F shows a framing of wood, placed a little distance above the main frame, as seen in fig. 2, and supported by small blocks, *a a*, rising up from the cross-pieces, B B, in the plane of the wheels, D D, as seen at *a a a a*, in figure 1. The body of the cart or carriage is placed upon the framing, F F, which by its bearing upon the main frame at *a a a a*, in the plane of the wheels, does not tend to twist or strain either the main frame, or the wheels themselves; otherwise, the body of the carriage might be suspended from the under sides of the rails of the frame, at the points, *a a a a*. Fig. 3 on the annexed sheet of drawings represents a plan of the framing for a waggon or carriage having four wheels; the body of the carriage is supposed to be removed. Fig. 4 shows an elevation of the same: A A, the main rails of the frame, which are kept parallel by the four cross rails, B B and G G, being morticed into them: C C are two pieces, lying parallel to the main rails, and morticed into the cross rails, B B. These pieces form the openings to receive the hindermost wheels, D D, of the carriage, the bearings or pivots of which turn in collars fixed to the rails, A A, and pieces, C C, in the same manner as before described in the figs. 1 and 2. The cross rails, G G, have pieces, H H, morticed into them; and these again have a cross rail, I, fixed to them, which carries the traverse bolt or bolster, K, for the front wheels, E E, with their framing, *a a*, *b b*, *c c*, to turn round upon, when the carriage is intended to be turned in its direction. The front wheels, E E, are mounted upon short axes or axles, having a bearing and support in the pieces, *b b*, *c c*, on each side of each wheel (as before described for the hindermost wheels): L M, fig. 4, represent

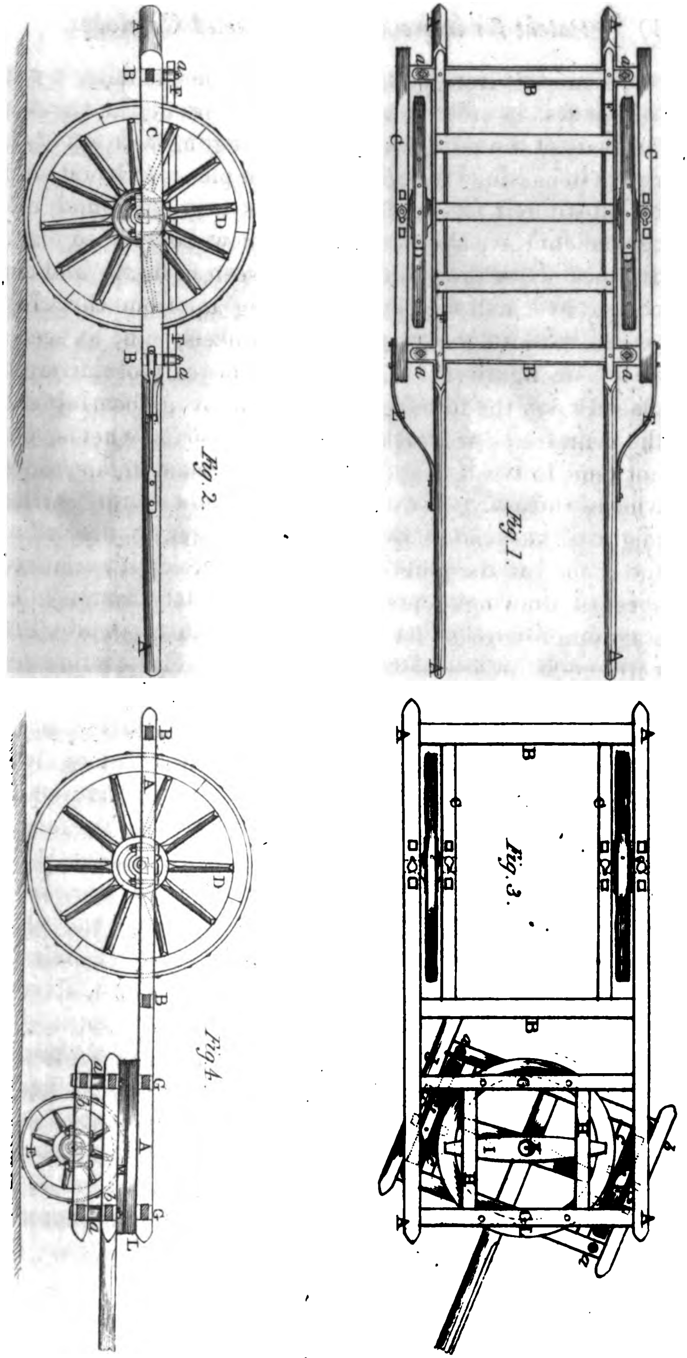


Fig. 2.
Fig. 1.
Fig. 4.
Fig. 3.

two circular frames of wood, placed horizontal, and lying in contact with each other (similar to ordinary four wheeled carriages); they are fixed concentric with the traverse bolt or bolster, K, and serve to steady the front wheels and their framing in turning. The wheels may either have the axes or axles fixed fast in their centres, and be made with pivots or bearings to turn in fixed collars, as herein-before described; or they may have boxes fixed in the naves of the wheels, adapted to turn upon fixed bolts or arms, extending across each of the openings where the wheels are to be fixed, always observing that the said bolts or axles do not extend across the framing of the carriage from one wheel to the other. Having shown how and in what manner the first part of my improvements is to be carried into effect, it remains for me to explain what part thereof I consider as my invention; as I wish it to be observed that I do not claim the invention of placing the wheels upon axes or axles, and supporting them on the outsides of the wheels, the same things having before been used. Neither do I make claim to any particular part of the framing of the carriage; but I confine my claim to the placing of each of the wheels upon a separate axis or axle, to be supported between two bearings or rails, and without having any bolt, axes, or axles, extending across the frame of the carriage, thereby leaving the wheels quite independent of each other, so as to allow of the load or body of the carriage being placed or suspended (if required) near to the ground, between the wheels, and even below the level of their axes or axles. At the same time I must state, that I only claim the application of this improvement to carriages having two, three, or more wheels. The advantages of placing the wheels of carriages according to my improvement above-mentioned are numerous. In the first place I am enabled to fix the axes or axles of the wheels horizontal (or parallel to the ground), and thereby obviate the necessity of dishing or hollowing the wheels; and also to render their action upon the roads less injurious, by

rolling over the ground instead of grinding upon it, as must be the case with wheels placed in a position inclined to the direction of their motion, such being the usual method of placing the wheels of carriages. Second, the rail which extends along the outside of the wheel (to support the outer pivot of its axis or axle) is an effectual defence to the wheel, and serves to protect it from blows or shocks which it might otherwise receive by other carriages running against it; the said rails also obviate, completely, the inconvenience and risk of carriages becoming locked together, by the wheel of one carriage being forced in between the wheel and body of another carriage, which accident tends to strain the wheels very much. Another important advantage of my improvement is, that the axes or axles of the wheels do not extend across the frame or bed of the carriage from one side to the other, by which circumstance I am enabled to obtain a large clear space between the wheels, for the purpose of containing heavy merchandize, and carrying it near to the ground, for the facility of loading and unloading the same; and furthermore, without the risk of overturning, as must be the case in carriages as heretofore constructed, with the axes or axles of the wheels extending across the carriage, from one side to the other, thereby obliging the load to be carried at a considerable height from the ground; for the same reason I can make use of wheels of a larger diameter than what are usually employed, by which means the carriage would travel over rough and uneven roads with more facility. And lastly, the placing of the wheels upon separate axes or axles, with a bearing on each side, and independent of each other, would be of considerable importance for carriages to be propelled by the power of a steam engine, or other mechanical force, since the wheels could be easily acted upon separately by the moving power, for the purpose of turning the carriage (or changing the direction of its course); at the same time the space between the wheels, not being interrupted by the axes or axles ex-

tending across the carriage, would admit of the steam or other engine, and heavy machinery, being placed in the vacant room between the wheels, near to the ground. The second of my improvements in wheeled carriages consists in the application of an additional wheel (to a two, three, or four wheeled carriage), formed like a hollow roller or drum, which drum may be caused to move or roll along the road (in order to advance the carriage forwards), by having a steam or other engine placed withinside of it in such manner, that the engine would tend to advance or climb up the inside of the drum; and so by its gravity to turn the drum round (in the manner of those machines termed walking wheels, which are used in cranes, &c.) and would roll it forwards, advancing the carriage along with it. To effect this, the drum may be furnished with one, two, or more endless racks, extending round its inside circumference, into which rack or racks a toothed wheel or wheels may be made, to engage, such wheel or wheels being put in motion by the power of the engine. By this arrangement, the toothed wheels being connected with the engine would, by their motion, always tend to advance up the inside of the drum along with the engine, and turn the drum round to roll it along the road. The toothed wheels may be kept in their places upon the racks by having high ledges or projecting rims formed on one side of each of the said wheels; such ledges or rims to bear against the sides of the racks. I should recommend the above described drum to be situated in the frame of a carriage, in place of the large or hindermost wheels, and be connected with the frame of the carriage by means of iron rods or arms, one end of which rods or arms should be jointed to the axis of the toothed wheels before mentioned, within the drum; and the other ends of the rods or arms should be jointed, or otherwise fixed, to any convenient part of the frame of the carriage, so that the drum, on rolling along, would necessarily move the frame of the carriage with it. The course of a carriage of this description could

be directed by turning the fore wheels round (with their frame) upon the traverse bolt or bolster, by means of a rack and wheelwork, or other similar contrivance, whilst the facility of turning might be greatly increased by making the roller or drum somewhat largest in the middle (or barrel shaped). The steam engine may be constructed in the same manner as those engines used for drawing carriages upon rail-roads, and may be applied to act within the drum in various ways.

In witness whereof, &c.

Specification of the Patent granted to JOHN STANLEY, *of Chorlton Row, Manchester, Smith, for certain machinery calculated for a more efficacious mode of fuelling or supplying of furnaces in general with fuel, whereby a considerable reduction in the consumption of fuel, the appearance of smoke, and of labour, is effected.* Dated July 27, 1822.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said John Stanley, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained by the following description thereof, reference at the same time being had to the annexed drawings, (see Pl. V.) in which said drawings the same letters or figures of reference are employed to denote the same thing, (that is to say:) The dotted lines, *a b*, *b c*, *c d*, represent a part of a boiler; *a b*, the top; *b c*, the end; and *c d*, the bottom of the said boiler; and as the bottoms of boilers are usually made convex upwards, *c d* represents the crown or highest part of the bottom: *e*, *f*, *g*, is a hopper or reservoir for coals, made of plate or wrought iron; *j i*, and *h g*, in fig. 1, are two plates of iron, forming the bottom of the hopper; the lower edges of these two plates are not brought together, but allowed to be about 3 inches distant from each other, so as to form an opening or slit all along the bottom of the

said hopper, in the direction of *j g*, in fig. 2, in order to allow the coals to fall through the said opening: A, in fig. 2, shows an end view of the said boiler; *k l*, in fig. 1, are two rollers, placed immediately below the opening in the bottom of the hopper, so as that when the coals fall through the said opening, they may fall upon or between the said rollers. These rollers I usually make 6 inches in diameter, and of a length corresponding to the width of the fire-place or grate to which the said machinery is intended to be applied; and I make the length of the opening or slit in the bottom of the hopper also to correspond with the length of the said rollers. The rollers, *k l*, (as represented in the drawings, figs. 1 and 2) are fluted; there are ten flutes in each roller, and each flute is 1 inch in depth. These fluted rollers are employed for crushing or breaking the coals, and for equalizing the quantity required for the supply of the fire, in equal and successive periods of time. The absolute quantity of coals required to be supplied in any given space of time is regulated by the number of revolutions made by the said fluted rollers in such space of time, and by the distance at which the said rollers may be placed from each other. Motion is given to the said rollers by means which I shall hereinafter describe, and I regulate the distance between the said rollers by the ordinary and well-known method of applying adjusting screws and sliding brasses or bearings to the axle of one of the said rollers, as shown at *m*, in fig. 1: *o* is one of two pinions, by which one roller turns the other, as in common use. Immediately below the aforesaid two fluted rollers, I place what I shall hereinafter denominate a fan; it is composed of an iron axle or spindle, *n n*, in fig. 2, lying horizontally and parallel with the aforesaid fluted rollers. Two or more sets of arms (as the length of the fan may require, two only are required for the length exhibited in the drawings) are fixed or hung upon the axle, *n n*, as shown in fig. 2; each set of arms has three points. These arms are shown

in figs. 1 and 2, at *o o*, &c. Upon the points of these arms I fix, by screws or rivets, three flat plates of wrought iron, *p p p*, of the same length of that of the aforesaid fluted rollers, of the breadth of 3 inches, and about one-eighth of an inch in thickness, so that the outside edges of the said flat plates or vanes, when turned round upon the axis, *n*, shall describe a cylinder of 16 inches in diameter. I enclose the aforesaid fluted rollers and fan in an iron case, of the shape represented in fig. 1, by the double lines, *g r s*, so as to exclude the air externally as much as possible. On the side next the boiler and fire-place I leave a rectangular opening, of the same length as the fan, and about 9 inches in height, from *s* to *u*, through which the coals are to be thrown by the fan on to the fire. I place the axis, *n*, of the fan, at the same height as the bottom of the boiler, represented by the line, *d*, *c*, and at the distance of 2 feet from the end of the boiler, denoted by the lines, *c*, *d*. The vanes, *p p p*, are made to revolve in the direction of the arrow, shown in fig. 1, between *r* and *s*; each vane will pass the bottom of the case at the distance of one quarter of an inch, and at the distance of about 3 inches from the front of the case, near *r*, where a horizontal line, drawn through the axis of the fan, and at right angles to it, would meet the circular part of the case, near *r*. D is the fire-door, made in the usual way, and is placed opposite the grate: B represents a part of one of the grate or fire-bars, in figs. 2 and 3: E is a screw (usually called an endless screw) of 4 inches in diameter, with a single thread fixed upon the axle of the fan: F is a wheel 9 inches in diameter, having 28 teeth, working or taking into the thread of the aforesaid endless screw, E. The said wheel, F, is fixed or hung upon the spindle, I; and upon the said spindle, I, is also hung another endless screw, similar to the one E: H is a wheel hung upon the axle of one of the fluted rollers, and is similar to the wheel F: the said wheel, H, is turned by the endless screw, G. I cause motion to be given to the fan by either toothed

or band wheels, as I may find it most convenient in procuring the moving power from some part of the machinery of the steam engine or other machine, which I may have an opportunity of employing for giving such motion; and to this end, I fix a wheel upon the axle of the fan, as is shewn at J, in fig. 2, taking care that the diameters of the wheels, and the velocity of the machine by which I am to give motion to the fan, be such as to cause the said fan to make two hundred revolutions per minute, or thereabouts. I have found that such a velocity will effect an uniform distribution of coals over a fire of 5 feet 6 inches in length. The relative velocity of the fan and the fluted rollers are as seven hundred and eighty-four is to one respective; that is, the fan makes seven hundred and eighty-four revolutions, whilst the fluted rollers make one revolution. Machinery of the dimensions hereinbefore described, would answer the purpose of supplying coals to a fire capable of working a steam-engine of from thirty to forty-horses power; and for a less or greater power, or for a narrower or wider fire-place, the dimensions of the various parts may be altered accordingly. The velocity of the fan must also be less or more, as the fire may be shorter or longer. The hopper for containing the coals may be made of any dimensions, suited to the situation and purpose to which the aforesaid machinery may be applied.

From reading this specification, and examining the annexed drawings, the construction, operation, and use of the machinery hereinbefore described, will be clearly understood by any competent mechanic. Although I have hereinbefore described the whole of the machinery, in order that the nature of my invention, and the manner in which the same is to be performed, may be better understood, yet I do not claim the hopper, the fluted rollers, the fan, the wheels, screws, or any other part of the machinery, in their individual characters, as forming any part of my invention; all of them having been before in-

vented, and used for a variety of purposes. But I do hereby declare that my invention consists in the employment and application of the fan, similar to the one hereinbefore described, in conjunction with the hopper, fluted roller or rollers, or with any other mechanical expedient capable of producing a regular supply of coals, so as that the coals so supplied may be, by the fan as aforesaid, thrown upon any fire or furnace.

In witness whereof, &c.

Specification of the Patent granted to ROBERT DICKINSON, *of Old Eagle Foundry, New Park-street, Southwark, in the county of Surrey, for an improvement in the manufacture and construction of metal casks or barrels.* Dated October 7, 1824.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said Robert Dickinson, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the following description thereof, that is to say :—The object of my invention is to produce an improved iron packing case or barrel, for containing goods and provisions of every description, but which is more particularly intended for victualling the ships of his Majesty's navy, and others that make long voyages. The improvement consists, first, in coating and covering the iron, both inside and outside, so as to defend and protect its surfaces from oxidation ; and secondly, to construct the cases or barrels in such ways as to render them convenient for receiving larger bodies than have usually been admitted by bung-holes ; in other words, having a large opening, sufficient to allow a man's head, arms, and shoulders to enter, for packing large bodies therein with

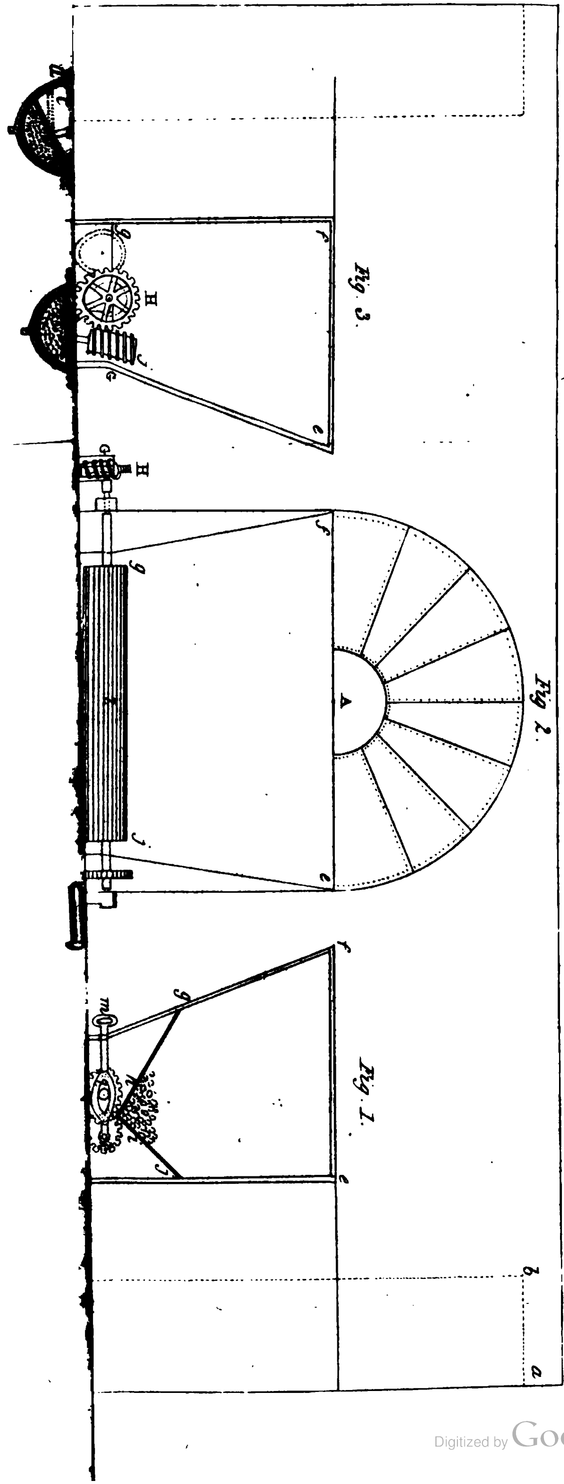


Fig. 3.
Fig. 2.
Fig. 1.
A
H
G
a
b
e
f
g
j
m

the greater convenience. My invention may therefore be said to consist of two parts, viz. the improved construction of the case or barrel, and the coating and covering of the iron. The manner, means, and materials whereby these objects are effected, are as follows. First, I will describe what relates to the construction of the barrel. The cylinder being formed in the common way, by rivets, soldering, or seaming, the manner of performing which is known to every workman, I make a hoop of iron, rolled, with one edge thin and the other thick; thus  (by some called a rebate). The thickest part of this hoop I fasten within the barrel, its thin edge extending to about one inch below the extreme end of the barrel, which being done, leaves a groove between the thin edge of the hoop and the barrel, see drawing. fig. 4, (Plate V.) *a a*, for the flange of the head to fit into. The groove being now rammed full of hemp, tow, curriers' leather shavings, a tar band, or any other similar substance, the head is put on its edge or flange, *b b*, falling into the packed recess. In order to render this head moveable at pleasure, it is supplied with a sufficient number of latch bolts (according to the size of the vessel), which latch bolts slide sideways into nicks, apertures, or openings, cut near the edge or end of the barrel to receive them; see fig. 5, *c c c*. These openings are formed somewhat out of a parallel line to the edge, so as to draw the head down the tighter when the side bolts are hammered into the holes; and also the latch bolts are made thinner at the end than at the shoulder, for the same reason. (See drawing.) I have been describing the moveable end, or that end which opens the reverse end is differently closed; it is indeed supplied with the same rebated hoop, but this hoop is to be placed about half an inch only from the end or edge, and then, when the head is laid on, or in its place, this half inch of the edge is to be bent over, and hammered tight down upon it. A flat ring, see fig. 6, *d d d* (which supersedes the necessity of a chime), is then rivetted down thereupon, so as to cover

this joint, having a trifling projection to defend the barrel in rolling. The head may either be flat, convex, or concave; the latter I think the best. Having described the construction of the improved part, as relates to the mere barrel, I next come to the coating or covering thereof; first, for its own preservation, and secondly, for the preservation of whatever it may contain, from the rusting or oxidation thereof. To render this process of coating the most perfect and complete, the iron should be pickled or scaled, and scoured in the same way as for tinning; but when time cannot be allowed for this process, or where cheapness more than durability (to send abroad) is the object, I omit this scaling part, and content myself with laying the composition and cloth with which I intend to cover the barrels on the unscaled plate. In some cases I coat and cover only the outsides, as not being necessary to coat the inside of barrels containing tar, oil, varnish, &c.; and as for the inside of barrels intended to contain other substances, the great variety of chymical decomposing effects produced thereby, compels me to have different internal coatings, and to change them in some instances, according to the nature and quality of the commodity they are to hold; and as for dry products, such as bread, rice, pearl barley, flour, &c. where it is necessary to provide against the injurious effects of weevil, rats, maggots, or other living animals, and where the iron is not at any time exposed to wet, and where, therefore, an insoluble composition is not necessary, I apply a simple adhering or connecting material, such as glue, or a well-made paste, and the very thinnest and cheapest canvass or cloth that can be found, and sometimes paper; hence it is to be observed, I do not confine myself to any single article of paint, varnish, or cement, or by whatever name it may be called, or any of the articles from which they are made, whether simple or compound; meaning to lay claim to the exclusive employment of all soluble, insoluble, or impervious cements, in attaching fibrous substances to the surfaces of iron, for the purpose of preserving iron

from rust, by covering with an intervening substance of a manufactured article or web, of any material or substance as aforesaid, whether of silk, cotton, linen, wool, leather, paper, or felt, however mixed or separate, from the thinness of a gauze to the thickness of a Turkey carpet or door mat, which, after saturating with any of the compositions suited for that purpose, and at a proper state of dryness, I pass between cylindrical rolls, in order to give it firmness and a consistency, with a capability to resist the admission of wet, or the influence and effects of chymical operations, arising from the various articles which the barrels or cases heretofore described may be used or required for. It may, however, be necessary to state definitely, what kind of cement will answer the above purpose. I shall therefore say, that I would take of caoutchouc (or Indian rubber) one pound, of black rosin half a pound, of Venice turpentine two ounces, and mix them together, allowing them to stand in a temperature of 160° for the space of twenty-four or thirty-six hours; the caoutchouc being cut into small pieces. In some cases I do not find it necessary to coat the insides of my barrels with the above materials; but to prevent rust, I bronze their internal surfaces in a similar manner to the surfaces of gun barrels.

In witness whereof, &c.

Specification of the Patent granted to BENJAMIN ROTCH, *of Furnival's Inn, London, Esq. for an improved fid for the upper masts of ships and other vessels.* Dated Aug. 21, 1823.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. &c. *Now know ye,* that in compliance with the said proviso, I, the said Benjamin Rotch, do hereby declare the nature of my said improved fid to consist in two levers, retained in

a position to support the mast which is above them by means of two pauls, one butting against the carriage of each lever; or by means of two bolts, one passing through each lever and its carriage; the carriages in both cases being made of metal, and such levers being in both cases so placed as to admit of the mast above them being lowered without previously slacking the rigging attached to it. And in further compliance with the said proviso, I, the said Benjamin Rotch, do hereby describe the manner in which I perform my said invention, by the following description thereof, reference being had to the drawings annexed, and figures marked thereon, that is to say:

DESCRIPTION OF THE DRAWINGS.

Drawing marked A, fig. 1, (Pl. V.) is a side elevation of one of the levers of my said improved fid, with its carriage, one side of which carriage is supposed to be removed for the purpose of showing the relative position of the lever and its carriage when the mast is fidded. In this drawing, the parts coloured blue are to represent wrought iron, and those coloured otherwise, cast iron or brass*: L is a lever, turning on axis or gudgeons, X; on the under side of this lever is a paul, P, turning easily on the pin, *e*, and abutting against the back part of the carriage at *f*. The rod and ring at R are for the purpose of lifting up this paul when it is required to lower the mast that is above it: G G G is the carriage, the lower part of which embraces the trussel tree, the front leg being let into the trussel tree, flush with the square for the heel of the top mast, while the hind legs pass down outside the trussel tree: B is a bolt passing through the trussel tree, and fastening the legs of the carriage and trussel tree firmly together: T is the bottom of the carriage. Fig. 2 is a plan of the upper side of the lever and carriage. Fig. 3 is a plan of part of the under side of the lever, showing its appearance when the paul is removed. Fig. 4 is a plan of the paul, and fig. 5 is a section of the paul. Fig. 6 is a side elevation

* The colouring is unavoidably omitted in the engraving.

of the carriage, H being a hole for the purpose of getting at the paul to clear it in case of difficulty; and fig. 7 is a back elevation of the carriage. Drawing marked B, fig. 1, shows a front elevation of a top cross trees and trussel trees, with the head of a ship's mast, and the heel of a top mast, and a pair of the lever fids supporting the latter: F represents the line of the fid plate, which for the purposes of the said invention should be three times the ordinary thickness, because it will be seen that the point of the lever which goes into the heel of the mast is cut at an angle downward from the plate, so that the weight of the topmast may rest as near the gudgeons as possible, which arrangement (in case the outer fibre of the wood should turn up) will throw a great strain on the fid plate. Fig. 2 is a side elevation of a lever, to be kept in a position for supporting a topmast by means of a bolt passed through the lever and its carriage, instead of a paul; this mode of securing the lever I call the bolt lever fid, and the mode hereinbefore described I call the paul lever fid: with reference to the figure now describing, *t* is an arched slot, cut in the lever, and the curve of which arch is struck from the centre of the gudgeon, x, while two circular holes are bored in the carriage, opposite to this slot, and opposite to each other, and a bolt put through them. When the weight of the topmast is on the short end of the lever, the bolt is kept tight in its place; but when the long end of the lever is pressed down as far as the support, *i*, will let it go, the bolt is at once freed, and may be drawn out, when the weight on the short arm of the lever will force it down, and (the bolt being drawn away) the long arm will continue to rise till the short arm turns completely out of the fid hole, in the heel of the mast, and the mast will slide down beside it. Fig. 3 is an elevation of the opposite side of fig. 2, and fig. 4 is the bolt. Having now described the various parts of my said invention, I will proceed to explain the manner of putting the same in motion, for the purpose of lowering or fidding a topmast.

It will be observed, by attending to the arrangement hereinbefore described, that the mast will be supported on the short arms of levers, applied on the principle of steelyards, which turn on their axis at x. In the case of the paul lever, the use of which I am now about to describe, the long arm of the lever is kept from rising by means of the paul, which, by the weight of the topmast, is pressed so hard against the back part of the carriage at *f*, that it will not rise till freed from that pressure. In order to free the paul, the long end of the lever, L, must be pressed downwards, either by means of a burton or otherwise, till the part, *r*, of the lever, comes down upon the part, *s*, of the carriage, by which motion the paul will be advanced forwards from *f*, and may be pulled upwards by means of the rod and ring at R: while the paul is kept up in this position, if the long arm of the lever be suffered to rise, the weight of the mast will cause the short arm to descend, till it comes completely out of the fid hole, when the mast may be lowered away by the top tackle pennants. The mast being lowered, the operation of fidding is performed as follows:—The mast is hoisted up by the top tackle pennants till the fid hole is fairly in sight, when the short arms of the levers will enter into it, and a burton or other purchase being applied to draw down the long arms of the levers, the mast will be forced up into its place; while the paul, P, the moment it has passed down the inclined plane from *f*, will fall into the position shown in fig. 1, drawing A, and keep the topmast in its place. The manner of applying the bolted lever fid is nearly similar to the last-mentioned, except that when it is required to lower the mast, the long arm of the lever is pulled down till the stud, *i*, which is tapped into the under part of the lever, comes down upon the bottom part of the carriage, when the bolt, fig. 4, drawing B, may be drawn out, and the long arm being suffered to rise, the mast will descend as before; and when it is required to fid the mast, the long lever being again pulled down till the stud, *i*, touches

the bottom of the carriage, the bolt may be easily replaced, when the force applied to the long arm of the lever being removed, the pressure of the topmast on the short arm will bind the bolt so tightly against the front part of the slot, that it will be kept steadily in its place. It will be observed, that in the carriage for this bolted lever fid, no inclined plane or back stop will be required. The said improved fid, as shown in the drawing marked A, represents the main top gallant fid of a vessel of about 300 tons, half size; and those shown in the drawing marked B, represent the fore topmast fids of a frigate, of about 1000 tons, drawn to a scale of one inch to a foot. Now whereas a lever or levers may have been used heretofore, for the purpose of assisting to raise a topmast to its place; but two such levers as aforesaid, fitted with metal carriages as aforesaid, and applied for the purpose of fidding and unfidding the upper mast of a ship or other vessel, and retained in a position to support such upper mast by means of two pauls, one attached to each lever, and butting against the carriage of the said lever, as hereinbefore described, or otherwise, by means of two bolts, one passing through each lever and its carriage, as hereinbefore also described; and by means of which said levers a mast, having been first fidded with them, may be unfidded, without previously slacking the rigging attached to it, being, to the best of my knowledge and belief, entirely new, and never before used in these kingdoms. I do hereby declare this to be my specification of the same, and that I do verily believe this, my said specification, doth comply in all respects fully, and without reserve or disguise, with the proviso in my said hereinbefore in part recited letters patent contained, wherefore I do hereby claim to maintain exclusive right and privilege to my said invention.

In witness whereof, &c.

Description of balanced or swinging masts, to be applied to sailing boats and other light vessels, invented by Mr. RAPHAEL CLINT.

From the Transactions of the Society of Arts, &c. Vol. XLII.

The sum of Twenty Guineas was voted to Mr. Clint for this invention.

WITH AN ENGRAVING.

THE inventor has for some years past been connected with nautical science, as a pursuit of pleasure, mostly on the boisterous west coast of Scotland; and he is fully aware of all the vicissitudes to which vessels are exposed, and has a correct knowledge of their tactics.

This invention, now offered to the Society of Arts, &c. was originally intended for open boats; but, on trial, it appeared that, under the various modifications of which it is susceptible, it may be most advantageously adopted for decked vessels, being particularly well adapted to the use of such of them as are employed only for fast sailing, without regard to the carrying of cargoes. Of this class are revenue cutters, mail packets, pilot boats, pleasure boats, and others; and when the many important advantages resulting from the invention shall become known, none of these will refuse to make the allowance of the space required for the cradle, which will be about the same as that occupied by the engines of a steam boat. One of the objects of this plan is to enable a vessel under a press of sail, *close hauled*, to preserve an upright position upon the water. The advantages of which position are,— 1. The vessel will sail faster by dividing the water better at the bows, and by drawing less dead water at the stern. 2. The vessel will answer the helm much better. 3. The vessel will go better to windward in that position than in the awkward state of sailing upon her side. Another object is to prevent the loss of lives and property consequent upon the frequent upsetting of vessels in squalls of wind, or by inattention or fool-hardiness; for a vessel on this construction is found on trial to maintain her upright position, however violent the wind.

The model before the Society is that of a sailing vessel, six feet long, and only *nine inches broad;* of which the following is a brief description. In her hold, a semicircular cradle is suspended on the centres between two beams; in this cradle is placed a quantity of ballast, or part of cargo; in the cradle the mast is raised, and to the sides of it are fixed all the rigging, haul yards, &c. the whole being decked in: in other respects there is no material difference above deck from ordinary vessels. A boat on this construction is enabled to carry nearly three times the common quantity of sail *close hauled*, and from its great length of shape sails with proportionably increased velocity; and however violent the pressure of the wind, the *hull* of the vessel always maintains an upright position in the water.

The preceding remarks have reference only to the application of this principle to vessels of the ordinary form; but a more important advantage, as far as relates to fast sailing, results from this construction, consisting in the diminished breadth of the vessel. The proportion of length to breadth in the model before the Society is as seven to one, and the ordinary proportion is as three to one, by which four-sevenths less of resistance is given to the progress of this vessel through the water, giving her four-sevenths of accelerated velocity in sailing.

Length, if it can be applied, is a great desideratum: it enables a vessel to go over a heavy sea with ease and speed, by making the angles of elevation and depression upon the waves less acute: it makes a vessel sail more steadily, and hold a good wind: it enables a vessel to lie at anchor and ride out a gale in greater safety, by diminishing the strain upon the cable.

To all these advantages the plan has the merit of extreme simplicity. Every stay, haul yard, brace, sheet, tackle, and sail, is in the same place as in an ordinary vessel; and consequently, in manning a vessel on this principle for sea, the sailors would have *nothing new to learn.*

In conclusion, it may not be impertinent to remind the

Society of the various means adopted by the natives of the shores of the Pacific and Indian oceans to make their long canoes carry sail.

There are the double canoe, the catamaran, the canoe with bamboo canes placed out upon cross poles, and the canoe with one side flat, and a man out to windward upon a spar: these serve to exemplify the utility of length, but are fit only for an amphibious people, and are practicable only on a small scale.—See *Lord Anson's description of the Flying Proas of the Ladrone Islands.*

RAPHAEL CLINT.

In the month of May last a whale-boat was fitted up by Mr. Clint according to the above plan, and several experiments were made on her in the river Thames; on one occasion she sailed down to Erith with a full spread of canvas, and upon nearly an even keel, at a time when, from the boisterousness of the wind, the Gravesend and other sailing boats were working under reefed sails, and running nearly gunwale to. Of the novelty of Mr. Clint's plan, and its practicability to at least a certain extent, there appears no doubt; and therefore the Society have thought themselves justified in offering it to the attention of the public, without, however, pledging themselves that in its present state it is applicable safely and usefully to marine navigation.

Reference to the engraving.

Fig. 13 (Pl. V.) represents the relative position of the mast and hull before sail is set.

Fig. 12 represents the same when the vessel is under a press of sail close hauled.

a The hull. *b* The mast attached to the cradle, *c*: the lower part of the cradle is partitioned off to contain the ballast. *d* One of the pivots, by means of which the mast and cradle are suspended, allowing them to swing laterally, while the hull preserves its upright position.

New mode of supporting the topmasts of ships, invented by Mr. G. Smart, *Pedlars' Acre, Lambeth.*

From the Transactions of the Society of Arts, &c. Vol. XLII. The Gold Vulcan Medal of the Society was presented to Mr. Smart for this invention.

WITH AN ENGRAVING.

The common mode of supporting a topmast is by means of a fid, or bolt, of iron or wood, which passes transversely through the mast near its base, and rests, by its two ends, on the tressel-trees, which form part of the top or frame-work of timber, which, together with the cap at the head of the lower mast (through which, also, the topmast passes), supports this latter in a vertical position. It is also supported laterally, in two opposite directions, by the shrouds, which are strong ropes fixed at their lower end, some to the side of the vessel and some to the top of the lower mast, and all of them secured, at their upper end, to the head of the topmast.

In heavy gales, when a vessel is under weigh, or at anchor, the impulse of the wind against the mast is such that it acts like a power applied at the end of a very long lever to bury the lee side of the hull in the sea. The obvious remedy for this would be to lower or slide down the topmast, and thus to reduce the length of the lever; and, to a person unacquainted with practical navigation, the only operation apparently requisite for this purpose would be to knock out the fid, and then to lower the topmast through the interval between the two tressel-trees.

The weight, however, of the topmast, with all its appendages, occasions so enormous a pressure on the fid that it is found quite impossible, by any power which can in that situation be applied, to drive out or withdraw the fid without previously taking off the pressure. This is done, or rather attempted to be done, by attaching a rope to the heel of the topmast, leading it through a block

hooked on to the cap of the lower mast, and then conveying it below to the windlass, or any other power that can be most conveniently made use of. But as in gales of wind the shrouds are always drenched with wet from the spray and the rain, and as a dry rope always shortens by being wetted, it follows that the tension of the topmast shrouds is at such times acting in the same direction as the weight of the topmast, and in direct opposition to the heel rope, on which account it rarely happens that the fid can be relieved.

The tension of the shrouds may indeed be taken off by slackening them; but, in proportion as this is done, the lateral support of the topmast is diminished, and the most imminent hazard is incurred of its being blown away. To lower the topmasts, therefore, while a ship is under weigh, however conducive it may be to the ease and even to the safety of the vessel, is a manœuvre not often successfully attempted even on board men of war, and scarcely ever on board merchant-men, which are always scantily manned.

The above-mentioned very serious objections to the common way of securing a topmast have induced Mr. Smart to propose the following plan, which, although as yet it wants the sanction of experiment, has been taken into consideration at two successive committees; and from its there obtaining the unanimous approval of naval officers and other professional men, is now offered to the public through the medium of the Society.

A little below the *hounds*, or shoulder of the lower mast, which supports the frame-work of the top, is to be formed a step, *f*, fig. 14, (Pl. V.) This may be done by bolting a fish to the mast in that part, if the mast is a single tree; but if built of several spars, as all large lower masts are, there will be no difficulty in making the step without the use of a fish. The face of the step is to be a plane declining outwards, and is to be strongly plated with iron or copper. A shoulder fitted to this step, and like it covered with metal plate, is to be cut in the heel of the topmast, *b*: the

whole weight of the topmast will therefore rest on and be supported by the step in the lower mast, and as the area of the step will be at least equal to that of the top of the fid-hole, *h*, the one will be no more liable to crush in by the superincumbent weight than the other. In order to prevent the topmast from being thrown off its step by any lateral motion, a wedge, *g*, figs. 14 & 15, is driven between the topmast and the cross tree, *e*. The fid, *h*, is proposed to be retained, but only as a preventer in case of accident; for the bottom of the fid hole being placed an inch above the tressel tree, *dd*, it is manifest that it bears no part of the weight of the topmast as long as this latter rests on the step, *f*.

In order to strike or lower the topmast, the heel rope, with its tackle, is first to be applied, then the fid, *h*, is to be withdrawn, after which the wedge, *g*, is to be knocked out; and this will be done with comparatively little difficulty, because the lateral pressure of the mast cannot be much, and because any difficulty likely to arise from this cause may be obviated by proportionally increasing the angle of the wedge. Nothing now remains but the exertions of two or three men, with handspikes inserted between the two masts near the tressel trees, to trip the topmast off the sloping step, *f*, and to lower it in the usual way by means of the heel rope.

References to the engraving.

Fig. 14 is an elevation. Fig. 15 is a section.

a The upper part of the lower mast. *b* The lower part of the topmast. *c* The cap. *d d* One of the tressel trees. *e e* The cross trees. *f* The step on which the topmast is supported. *g* The wedge by which the topmast is secured in its place. *h* The preventer fid.

Observations on Mr. BROWN'S *Vacuum Engine.*
Commmunicated by a correspondent.

GREAT expectations have been excited in the public mind respecting this engine, the specification of which appeared in the 45th vol. of the Repertory of Arts, &c.; but of the wonders which it was to perform, none have yet, I believe, been exhibited in an operative shape; and we are still to look forward for the fulfilment of its mighty promises.

Many persons at first thought, that in it a real vacuum was to be produced, by burning pure hydrogen in the portion of oxygen proper to produce water; but it turns out that the word vacuum is used on this occasion in an improper sense (which probably caused this error), and that it is intended to denote a degree of exhaustion of the working cylinder of the engine, equal, at most, to a column of 23 or 24 inches of mercury, which is far short of a vacuum.

Coal gas, in this engine, is contrived to be burned in atmospheric air, to produce the degree of exhaustion of which it is capable (which I doubt much to be so great as stated). This, however, cannot proceed from the mere reduction in volume of the mixed gases burned, since coal gas, or carburetted hydrogen, burned in the proportion of 170 parts with 100 parts of oxygen, will produce 100 parts of carbonic acid gas, (*See Dr. Henry's paper on coal gas, &c.*) and as atmospheric air contains but 27 parts of oxygen in 100, of course the 73 hundredths of azote left will have to be added to the carbonic gas. Now as very nearly 373 parts of air will be necessary for the 170 of coal gas mentioned, there will remain, after the combustion, 272·29 of azote, and 100 of carbonic gas, in all 372·29 parts, out of 543, which is, within a very small fraction, one half of the whole quantity originally introduced.

It is evident then that the effect is not produced by the burning out, or condensation of the gases; but by the

explosion of the mixture, or by the expansion caused by its flame, when this does not amount to what would be called an explosion, though in all cases it is a degree of it.

Here then we come on other grounds, which I am much surprised have not been noticed before in the many publications which have treated of this engine. In the 2d part of the 1st vol. of the Transactions of the Cambridge Philosophical Society (which were published considerably more than a year before the sealing of Mr. Brown's patent), there is an account given of an engine on precisely the same principles last explained, invented by the Rev. Mr. Cecil, of which account there is an extract published by Dr. Brewster, in the Edinburgh Philosophical Journal for October, 1822, (v. vii. p. 362) that may perhaps be more readily consulted, as being in more extensive circulation.

Of this extract the following is the substance:—"The principle of Mr. Cecil's invention appears to be, that a mixture of one part of hydrogen, and $2\frac{1}{2}$ of common air, will expand, on being exploded, to three times its bulk, and then instantly collapse to a sixth of its original volume.

"A cylinder, with a piston and a light valve at its other end, is the chief apparatus. The hydrogen gas admitted into this, and exploded by a jet of flame through a touch-hole at the side, will drive out the most of the common air from the cylinder by the end valve, which will clap to by the condensation afterwards, and force down the piston, by whose action the other valves, which admit the air and the gas, are opened; when it again rises by the action of a counterweight, or of a fly wheel, and the same process is again repeated."

On this extract I will leave your readers to make their own comments; only premising that, as the invention was thus evidently first published by Mr. Cecil, whatsoever merit it has is that gentleman's undoubted right. And here I beg leave to state, that all engines, where explosive mixtures are burned, are most dangerous to the lives and property within their vicinity; and that the mixture of coal gas and air is eminently of this nature, we

have too many common examples to need the statement of chemical facts. This must be the case, even where philosophical gentlemen carefully attend to the performance of such engines; what then must be the danger, when left to the management of ignorant labourers? which must, more or less, occur, if they come to be used as first movers for manufacturing purposes.

A paper by Mr. T. Tredgold, (which corroborates the foregoing statement) on the theory and power of this engine, and comparing the latter with that of the steam engine, has been published in a late number of the Edinburgh Philosophical Journal, wherein he has entered into some very minute algebraical calculations on the subject, which prove the inferiority of the former. Mr. T. shows that if oil gas is used with the gas engine, 270 cubic feet of it, at a cost of 10s. will be necessary to produce the effect of a bushel of Newcastle with the steam engine; and that if coal gas be used, that 482 cubic feet of it, at a cost of 5s. 9*d.* will only have the same power; which even in London, where coals are so dear, will be nearly five times the expence that a steam engine would require in doing equal work.

If worked with oil gas, Mr. T. thinks that a jet of flame, of a temperature equal to 1050°, might be made to fill a cylinder of a small size, and produce an exhaustion capable of sustaining a column of mercury of 20 inches (which, however, is not two-thirds of what a real vacuum would perform); and concludes with observing, that "the advantage of this increase of moving force is, however, not so great as to repay the increased consumption of gas necessary to produce it; and that the exchange of steam boilers for the retorts and gasometers of a gas work, will certainly not be esteemed an advantage; while, for a locomotive engine, the expence would be so great as to put it entirely out of the question, whether it would be better to carry oil gas, compressed to a 30th of its bulk, or to use a high pressure steam engine."

B.

Remarks on a paper inserted in the Philosophical Magazine, by Mr. W. Herapath, on a compensating pendulum. By a Correspondent.

Mr. Herapath, in a paper inserted in the Philosophical Magazine, No. 325, calculates, from experiments which he recites from several good authorities which he names, that if a pendulum be constructed as usual, of three inches of watch spring, and the remainder of iron wire, that its expansion for 1° Fahrenheit will be—

3 inches steel,	·000022830
36·139290 iron,	·000250600
	·000273430

which would be counteracted by that of 16·35 of zinc. But as this cannot be applied without adding more iron, the zinc must be increased by so much as will also counteract that addition; and yet the zinc must not be greater or less in length than the iron added, the exact quantity of which Mr. H. computes to be 27·92 inches.

The expansion of the pendulum rod will then be, for 1° of Fahrenheit,

3 in. steel, . . .	·000022830,	& of 27·92 in. zinc,	·000466822
36·139290 iron	·000250600		
27·92 iron, . . .	·000198542		
	·000466972		

Having thus determined the length of the zinc necessary, Mr. H. thus applies it. The pendulum rod is made as usual in common clocks, with three inches of steel spring attached to an iron wire, having a foot firmly fastened to it; a tube of zinc, 27·92 inches long, is slid over this rod, and fastened to the foot; an iron tube is now put over this zinc tube, and at the top is fixed by a screw to the top of the zinc tube. The bottom of the iron tube is connected with the pendulum ball. Here ends Mr. H.'s account, with a reference to a figure given in the original, which he states will give a better idea of the instrument than any verbal description.

In this figure, besides the parts above mentioned, there are two screw collars represented, one at the top of the zinc tube, and the other at the end of the iron one, for regulating their length; and a piece of wire descending from the collar at the bottom of the iron tube to the bottom of the pendulum ball, where it terminates in a screw; a nut turned on which supports the ball and shortens or lengthens the rod as required.

It seems strange that the author, who appears to have paid great attention to the precision of his calculations, should have made such a material error in the description of the execution of his plan, as to have directed the last-mentioned wire (which connects the bottom of the iron tube with the bottom of the ball), to be added to the rest, without having made any allowance for its expansion downwards. I can scarcely suppose, however, that he could have intended that this wire, which is a fifth of the length of the steel spring and first wire of the pendulum taken together, should have been added to the entire length, as that would have made the pendulum near 47 inches long, though his direction that "the pendulum rod is to be made as usual in common clocks," to whose end the foot is to be fastened to support the zinc tube, certainly bears that meaning; for if made as usual, it must be, together with the steel spring, 39·1392 inches long; but in matters of this nature, which depend on exact proportions, this inaccuracy of description is at least improper. On this last supposition I will take the liberty so far to correct the description, as to advise that the steel spring, with the wire from it to the bottom of the zinc tube, and the wire from the bottom of the iron tube to the bottom of the ball, be collectively of the length of an ordinary pendulum.

Mr. H. has also neglected to make any allowance for the expansion upwards of the ball of the pendulum from the nut which supports it. This error I will also remedy for the author, by recommending that the nut be placed

in the centre of the ball, as has been already practised by careful artists, instead of at its bottom, as the figure directs.

From an account of a tubular compensating pendulum, made by the late Mr. Patoureaux, clock-maker, formerly of Wardour-street, it appears that tubular pendulums were made as early as 1775. Mr. Troughton also published an account of one made by him in 1808. Mr. Herapath's is, however, different from any of these, in the materials and their arrangement, and probably would succeed as well as the best of them, with the corrections before mentioned.

But I conceive that there is a course of inaccuracy in the very nature of tubular compensating pendulums, which renders them inferior to others of a different construction; for in them the tubes and wire, or metallic rod, of which they are composed, consisting of very differently sized masses of matter, and with different exposures to the air, cannot be effected simultaneously by the atmospheric changes of temperature. For example—the wire, having a great surface in proportion to its solid contents, will more rapidly come to the temperature of the air on a rise of the thermometer, than the tubes; and of those the internal one, being moreover, as it were, clothed by that which is external, will change its length more slowly from the same cause, which must produce an irregularity in their compensating effects.

These considerations should by no means be esteemed fastidious niceties, as some may affect to call them, since the great point in question in such contrivances is evidently precision; and where that is immaterial, a cuckoo clock, with its rusty wire and wooden bob, may perhaps do as well as more expensive machinery.

W.

Method of making transparent Soap.

From Archives des Découvertes et des Inventions Nouvelles.

TALLOW is the basis of all soaps for the toilette, known under the name of Windsor, because olive oil forms a paste too difficult to melt, and having an odour too powerful for mixing with perfumes.

Tallow-soap, dissolved with heat in alcohol, returns to its solid state on cooling. It is this fact which has led to the discovery of transparent soap. When well prepared, this soap should have the appearance of fine white sugar candy. It may also be coloured, and vegetable colours are, for this purpose, preferable to minerals. Any person can make this soap by putting into a thin glass phial half a brick of Windsor soap, cut small, filling the phial half full of alcohol, and placing it near the fire till the soap is dissolved. This mixture, put to cool in a mould, gives the transparent soap.

On the employment of the wood and bark of the chesnut-tree in dyeing and tanning.

From Annales de l'Industrie Nationale.

THE bark of the chesnut-tree contains twice as much tanning matter as oak-bark, and nearly twice as much colouring matter as log-wood. The colouring substance of chesnut-bark is to that of campeachy log-wood exactly as 1·857 to 1.

Leather prepared with this substance is more firm and solid, and yet more supple. This bark is the best substance for making ink; mixed with iron it becomes a bluish black. The liquor drawn from this bark appears blue at the outside, like indigo; but it gives, on paper, the finest black. In dyeing it has a greater affinity for wool than sumach has, and in other respects it differs very little from sumach and gall-nuts. The colour obtained from this substance is unchangeable by air and light.

NOTICES OF NEW PATENTS.

Patent granted to Messrs. SAMUEL DENISON *and* JOHN HARRIS, *of Leeds, for improvements in machinery for making wove and laid paper.* Dated January 1, 1825.

THE principal parts of this apparatus are, 1st, a reservoir or vat to contain the pulp; 2d, a trough to convey it to this vat from the vessels, &c. wherein it is prepared; 3d, a large hollow revolving cylinder, whose surface is formed so as to have the effect of the wire moulds used in paper-making; 4th, two endless felt webs, each revolving on a pair of rollers, lying in a horizontal position, and placed one above the other; 5th, a pair of smaller rollers, one placed in the interval of one of the webs, and the other opposite to it in that of the other web, where their axles are pressed together by screws, in order to press the water out of the pulp, as it passes between them along with the felt webs; 6th, another roller, placed beneath the felt roller of the lowest web, which is next the vat, and against which roller it is pressed by screws at its axle, to force the water out of the felt as it passes between those two rollers; 7th, a reel to roll up the paper as it is formed, which reel is placed of course at the furthest extremity of the apparatus from the vat; 8th, a very small and light roller, placed between the felt web rollers and the paper reel, whose office is to prevent the paper from sticking to the web; and 9th, a revolving frame within the vat (called a *hog* by paper makers), which by its motion keeps the pulp properly mixed up for use.

The vat for the pulp is hollowed beneath, in front, to admit the large hollow moulding cylinder to enter, so that the pulp may pass out from its upper edge on the surface of the cylinder, about half way between the vertical and horizontal planes of its axle. The revolution of the moulding cylinder brings the pulp in contact with the upper horizontal felt web, which lies nearly in the horizontal plane of its axis, at the opposite side from the vat; and in con-

veying it there from the vat, drains a considerable portion of water from it by its cribriform surface. The roller of this felt web, that lies next the moulding cylinder, is pressed against it by screws at its axis, so as to cause the pulp to adhere to it sufficiently to pass downwards along with it to the middle pressing rollers before mentioned, which nearly presses the rest of the water from it, and are therefore called the wet rollers: from thence it passes on between the upper and lower felt webs, to the pair of rollers furthest from the vat (where the two webs separate to return in opposite directions to the other rollers), and where it is again pressed by screws between those rollers, and thereby made sufficiently dry to be separated from the felt in a continued sheet, for which cause these rollers are called the dry rollers; and from them the sheet is taken by the little separating roller, and passed on to the reel, which, when full, is removed to the drying loft or stove; an empty one being always at hand to supply its place.

The upper and lower felt webs are only in contact between the wet rollers and the dry rollers; their two other rollers, next the vat, being set sufficiently apart to permit the webs passing in that place without touching.

Besides the nine rollers mentioned, the patentees use others covered with brushes, placed beneath the lowest felt web, to brush off any particles of pulp which may adhere to it.

A shaking motion having been found essential to the formation of the pulp into paper, when in the moulds, this is given in this apparatus, by making the legs jointed, which support the frame that contains the rollers, and by having a crank connected with the frame at one side, whose revolution gives the degree of concussion desired.

The motion from the mill shaft is first given to the dry or delivering rollers, and from them communicated to the other moving parts by suitable machinery.

To complete the account of this apparatus, we have now to describe the composition of the moulding cylinder.

This is formed of several metal wheels, placed on the same axle, about five inches asunder. The rims of the outermost of these wheels at each side are of greater diameter than those which are intermediate, so as to extend sufficiently beyond them, to allow of a groove for the reception of the ends of the small cross bars, which form the surface of the cylinder into a mould; and also to rise above them into a ledge at each side of the cylinder, about half inch high, similar to the deckles of the paper moulds, and for the same purpose of confining the pulp from passing off at either side. The small cross bars mentioned are made of copper plate, set edgeways in the plane of the radii of the cylinder across from side to side, and at right angles to the wheels, which form its internal framing. They are about three-eighths of an inch broad up and down, and of the length of the breadth of the cylinder, and have small projections on them at one side, at intervals of three-quarters of an inch (called nibs by the patentees), and of the same thickness as the bars. It is obvious that those little projections will keep the bars asunder when pressed towards each other on the rims of the wheels, sufficiently to form the surface of the cylinder (which their addition to its other parts completes) into a sieve-like form, similar to that of the common paper moulds; and capable of equal fineness. This arrangement of these bars of course goes all round the wheels, or disks, described, so as to entirely cover them, and form the surface of the cylinder. The ends of the bars are secured by the grooves in the outside disks or wheels, as mentioned; and where they cross those which are intermediate, they are fastened to them by soft solder, probably at the inside.

When paper is required narrower than the whole breadth of the cylinder, the interval between the external rims is reduced by endless straps, placed on the cylinder at distances suitable to the size of paper required, and so as to form moveable deckles.

The moulding cylinder described will form paper with

the common water-mark; and in order to enable it to make wove paper, it is directed to turn little grooves or lines on the outside of the upper bars, forming the surface of the cylinder as mentioned, and at distances from one another equal to the intervals of these bars, which the patentees aver will be sufficient to produce the smooth face required for that species of paper.

This seems a very compact and well-contrived apparatus for the purposes designed. In several particulars, however, it much resembles the machinery for which Messrs. Fourdrinier and Gamble obtained patents at different periods, [the term of which was extended 15 years by Act of Parliament, August 14, 1807, whose specification is inserted in the 13th vol. of the second series of the Repertory of Arts, &c. page 217], but is as much remarkable for its simplicity as that was for its complication, and vast number of parts.

The moulding cylinder is also very similar to one which is described in the specification of the late Mr. Joseph Bramah's patent for improvements in the art of paper making, sealed 25th April, 1805, which may be seen in the 8th vol. of the second series of the Repertory of Arts, &c. page 1, but certainly is of an improved construction; for Mr. Bramah's cylinder was only covered with wire, worked over like the surface of a common paper mould, and supported by cross bars underneath, in the same manner, which is by no means so strong or substantial a mode of covering it as that of the patentee's, nor in any respect equal to it in ingenuity of contrivance.

This apparatus for making paper may therefore be considered as originating from the patent inventions of Messrs. Fourdrinier and Gamble, and of Mr. Bramah for the same purpose, but containing substantial improvements, and excelling them in the particulars mentioned.

Patent granted to Mr. PIERRE ERARD, *for improvements in pianofortes, communicated to him by a foreigner.* Dated January 5, 1825.

The inventions comprised by this patent relate, first, to means of strengthening the wrest-board, to prevent its being twisted and distorted by the great tension of the strings; and also to prevent this cause from operating in a similar manner on other parts of the frame of the instrument; and secondly, in new arrangements for the parts that communicate the impulse of the key to the hammer.

The method which the patentee directs for effecting the first mentioned object is, to fasten sheet iron plates on the bottom and the side of the wrest-board by screws, and to extend straight pieces of bolt iron across the inside of the frame of the piano, in five or six places, at equal distances, which (according to the drawings of the specification) are crossed by others which run longitudinally, and thus form, by their sections, a number of compartments of the shape of oblong squares. Some of these bracing pieces have screws at their extremities, acting outwards, to regulate the thrust in the parts where they act.

The second object of the specification is effected by attaching to the farther end of the key those pieces which communicate its motion to the hammer, and which usually are arranged in a different mode. These are of a very complicated composition, some containing seven and some eight parts, including a spring, rising vertically over the key; besides which, there are other pieces fixed to the key, for acting on the dampers.

There are directions given in the specification, with very good figures, for applying these inventions to upright pianos, as well as to those which are horizontal, of which we shall only notice that the keys of the former are bent downwards at about two-thirds of their length into an angle of about 45 degrees; and that the joint or centre of motion, instead of being at the angle, is fixed between it and the front.

"If strength and stability were the chief objects for this instrument, then would we say that the above inventions for this purpose were great improvements; but as the tone of the piano is a primary point, we must hesitate in commendation, greatly apprehending that so much iron work, and so many stiff braces, must destroy those fine vibrations of the wood, on which its excellence depends. In a violin, every one knows what a sad effect such braces and platings of iron would produce, and how they would transform it from an instrument of music to an instrument of torture, at least to an ear of any delicacy of sensation; and we can see no cause why they should not produce, in some degree, a similar effect on the pianoforte.

We also object to the apparatus placed on the ends of the keys to act on the hammers, both on account of the weight which they must add to the keys in fingering, and for their complication, and inadequate fastening to the keys, which must render them liable to perpetual derangement; while the increase of workmanship, which they would cause, must add greatly to the price of the instrument, already sufficiently costly.

The keys of the upright pianos, described by the patentee, have the above defects, if possible, worse than those of his horizontal instruments.

Patent granted to Messrs. GEORGE SAYNER *and* JOHN GREENWOOD, *for improvements in the mode or manner of sawing and cutting wood and timber by machinery.* Dated January 11, 1825.

THESE improvements consist in placing circular saws above and below the timber that is to be sawed, one a little behind the other, so that their edges may pass its central line, and thus cut it quite through.

A number of these saws, placed on the same axis, and separated from each other by flanches of the thickness of the pieces required, are used in this manner to cut several

boards at once from one piece of timber; and for cutting scantling there are added, at the sides of the timber, horizontal saws on vertical shafts, arranged in a similar manner.

To rasp log-wood and other dye-woods, a number of circular saws are placed *close together* on one axis, and their joint action, when used, cuts the whole wood into saw-dust. The shape of the teeth of the saws for this last purpose, which the patentee calls the "half diamond" form, presents the figure, when seen sideways, of angles of 45 degrees, one side of which lies in the line of the radius of the circular saw, and when viewed endways, exhibits the form of so many chevrons (as they are called in the language of heraldry), by which they constitute a number of pointed edges for acting on the wood, similar to a species of chissels used very commonly in turning, and also resembling the points of the common graving tools used in copper-plate engraving.

The apparatus used for moving the timber towards the saws is formed of a number of rollers with axles, placed in a horizontal line, at equal distances asunder, on which the timber is laid. Of these the roller next the saws is moved round by the same machinery which turns the saws, with the lesser degree of speed necessary in impelling the timber. Above this roller and the timber, is placed another horizontal roller, which is made to press the timber against the lower roller by two vertical pieces that ascend from the ends of its axle, across the tops of which another shorter piece is laid, over which a horizontal lever passes that is jointed to a post at one end, and has a weight appended to its other end, which, to give it more power, is three or four times more distant from the cross piece than is the centre of motion. A large vertical drum wheel is placed above the whole, from which leather bands or straps, passing to pulleys on the impelling roller, and the shafts of the circular saws give the one the motion requisite for moving on the timber, and the others that for cutting it.

Circular saws have now been so long in use, and have been applied to such a number of purposes, that it is scarcely probable any new application of them can remain to be adopted, and open to the exclusive right of a patent.

In Mr. Samuel Bentham's very voluminous specification of the patent granted to him, April, 1793, (for which see Repertory of Arts, 1st series, vol. X. p. 21,) a numerous variety of modes of using circular saws, for a great many different purposes, may be found, which, both as to position and combination of these instruments, leaves it scarcely possible to add any thing new.

We fear, therefore, for these reasons, that the apparatus of the patentees, however ingenious and effectual it may be, can have but little claim to the exclusive monopoly of a patent.

Patent granted to Mr. James Falconer Atlee, *for a process by which planks and other scantlings of wood of every description will be prevented from shrinking, and be improved in their durability, closeness of grain, and power of resisting moisture, &c. &c.* Dated January 11, 1825.

In this process the wood is first to be sawed into the planks or square scantlings wanted, with the sides parallel to each other, and then to be planed; which afterwards are to be passed between metal rollers several times, the rollers being screwed closer together each time. For the same purpose several pairs of rollers may be used, arranged in a line, and successively closer together as more remote; the passing the scantling through which will save time, and prevent the necessity of altering the screws, which force them closer together, so frequently. In this operation the sap of the timber is pressed out, and visibly exudes from it, and the wood shows but little tendency to swell again, even when wetted, and becomes harder, heavier, and closer, and less liable to wear or decay.

It is necessary to increase the pressure of the rollers

gradually, for if this is performed too rapidly the wood will be split and otherwise injured. It is not possible to lay down precise rules for the degree of pressure, as the different kinds of wood require different management in this respect.

For trennels, or coaks, the wood is to be first sawed square of the size required, after which its angles are to be planed off; and it is then to be forced forward by any adequate power, through several conical holes in steel plates, successively smaller than those used precedently, in a similar manner to the process used in drawing wire, except that the action of pushing is used instead of drawing.

By the operation described the patentee asserts, that Honduras mahogany may be made nearly as close and solid as that of Jamaica: and if one of the rollers be polished, will have the side next it polished also. He moreover states, that this process will greatly improve timber for ship building, and for other building purposes; for the construction of furniture, and for all other uses where close and compact wood is desirable; thinks that wood thus prepared will be found so useful as to become a new article of manufacture and commerce, and proposes to give it the appellation of *condensed wood*.

In May, 1812, Mr. Smart, of Westminster Bridge, obtained a patent for preventing wood from shrinking, by rollers and other means of pressure, in a similar manner to that of the patentee, the specification of which is inserted in the 22d vol. of the second series of the Repertory of Arts. The principal use which Mr. Smart made of this process was, in manufacturing staves for small casks, and for the species of soldiers' canteens made of coopers' ware.

It is evident that planks or scantling only can be used to good purpose in this process, which are quite free from knots; since the grain of knots running across that of the timber, and often at right angles to it, would form an insuperable obstacle to the proper action of the rollers where

they occurred, and not only make the pressed wood uneven in its shape, but in many cases cause it to split in two or more pieces, especially where the knots lay obliquely, and in some instances would stop the action of the rollers altogether. This circumstance would render the plan inapplicable to ship timber and to many other purposes; neither could treenels be prepared for the rollers as proposed by the patentee, as they never are made of sawed stuff, but always of that which is split, as the former would be always more or less cut through the grain. Perhaps, however, the method proposed of forcing them through conical holes in steel plates may be found serviceable.

Patent granted to WILLIAM HALLEY, *of Holland-street, Blackfriars-road, Surrey, iron founder and blowing machine maker, for improvements in the construction of forges and bellows.* Dated March 5, 1825.

THE forge of the patentee is designed to be portable; and its hearth forms the bottom of an iron box, which has fixed ends and back, and opens at one side. It has also a lid, whose hinges are placed above the twyre, which, when the forge is in use, can be raised vertically, and secured in that position by two bolts; but can be shut down and fastened by a hasp and padlock when the forge is to be laid by, and thus the whole forms a safe receptacle both for the tools and the moveable stand, on which it is to be placed when wanted, and which is contrived so as to be easily taken to pieces, and stowed within it. The four legs of this stand pass through four holes at the angles of a square iron frame, which they support at about a third of their length from the ground. The tops of these legs are made a little conical, and on these parts another square frame, of slighter composition than the lower one, fits down in a similar manner; and above this last frame the hearth is placed; through holes, in the angles of which the conical tops of the legs pass, and by their close fitting there, and in the two frames, make altogether a steady

support for the forge; the back of which, about the twyre, and the part where the coals lie, are made of cast iron, of considerable thickness, while the rest is made as light as durability will permit.

The bellows, which form another of the articles intended to be secured by this patent, are made square, like an organ bellows, that they may contain, in the space which they occupy, more air than those with an angular or pyramidical termination.

They are likewise formed with a plate-iron top and bottom, the weight of which acts in general sufficiently in working them, without its being necessary to use the weights usually appended to common bellows. To the edges of these iron plates, wooden frames are fastened by screws, and to these wooden frames the leathers of the bellows are nailed in the usual manner. These bellows are placed directly beneath the hearth of the forge, and are supported near the larger end by two gudgeons, that rest within hooks, prepared for them on the top of the lower iron frame, while the smaller extremity is fixed on the end of the same frame, that lies beneath the twyre; and from this last-mentioned part of them a pipe ascends and enters the twyre, through which pipe, of course, the wind is to pass when the bellows are worked, which operation is performed by an iron piece, shaped so as to form three sides of a square, whose two extremities are jointed to the lower square iron frame, while its third side hangs down below the bellows. From the middle of this lower side a piece projects at right angles, at the side opposite to the twyre, whose end is made forked, to hold a roller or pulley; and a handle being fastened into a socket at the joint of this apparatus, and rising obliquely upwards towards the tyre end of the forge, it follows that when this handle is moved to and fro, the pulley will be alternately pressed up against the bottom of the bellows, and withdrawn again downwards, by which means the bellows will receive the motion necessary for their action.

Besides this there is a sliding bar placed across at the upper square iron frame, that rests on the tops of the legs, by which the bellows are sustained up out of the way when required, which fits them better for ship use, especially at the times when the decks are scrubbed and washed.

This forge seems well calculated for the situation last-mentioned, as it is a considerable object on board ship to have every thing contrived so as to be stowed away in as little space as possible; and a forge is a very necessary appendage to a ship, particularly where long voyages are designed, when accidents may always be more or less expected, for the repair of which a forge would be indispensable. We suppose the patentee intended his forge entirely for this use, as it appears to us that the common portable forge on wheels, used in our military service, is preferable to it for locomotion on land.

The patentee, in his description of the stand for the forge, gives the two square iron frames that connect it together the appellation of *rings*, which perversion of language causes a difficulty in understanding the specification that deserves to be noticed, as the distinction between round and square is such as cannot be expected to be confounded, and therefore is the more puzzling when they are thus used as synonymous terms in a document, where precision is so highly necessary.

Patent granted to John Heathcoat, *of Tiverton, Lace-manufacturer, for an improved economical method of arranging machinery used in the manufacture of lace, and in that used in weaving and in spinning by power.* Dated 9th March, 1824.

The specification of this patent relates to the buildings for containing the machinery mentioned in the title, more than to the machinery itself, and of this, its frame-work alone is brought into use on this occasion.

The machines for making bobbin-net lace by mill work

have the sides of their frames four or five feet high, and some new ones designed have them much higher. The chief object of the plan for which this patent was obtained, is to make those sides an efficient part of the building for containing the machines, by converting them, by a small addition, into so many pillars, for supporting the floors, to which purpose the frames of power-looms, and those of the machinery used in spinning cotton, wool, and flax, are applicable also, and perhaps those used in other manufactures.

The advantage of this is evident in the saving of expence of the cost of so many tons of iron, which a building so arranged would require less than one where the pillars to support the floors were of this metal, and detached, as usual, from the machines.

To put this plan into execution, it is proposed, after forming the sides of the machines to act as pillars, to arrange them so on the ground floor—for example, that two rows of machines, with an alley between them, will occupy the space intended for the building. The addition necessary to the sides of the frame for this purpose will be, besides some addition to their length, flanches cast to them at top and bottom, at least at two sides, in the direction of the length and breadth of the mill, to tie them by bolts firmly to the beams, so as to prevent the entire combination, thus formed, from yielding either to a lateral or longitudinal thrust. A proper foundation having been, of course, first prepared for those pillars of double use, (either by iron frames or other substantial materials,) when they are placed on it as mentioned, the beams for the next floor, which are directed to be of iron also, are then to be fastened by screw-bolts above the upper flanches of the pillars, and to have proper longitudinal bars fixed between or over them, so as to brace the floor firmly in that direction, in the same way as the beams secure it from side to side. On these beams and braces the first floor is to be laid, which, to correspond with the rest of the building,

should be a combination of iron frames, with tiles of bricks, so as to be fire-proof. Over this floor, and directly over the lower pillars, another set are to be erected, in the same manner, to sustain the second floor, whose lower flanches, by this position, can be fastened to the beams by the same set of screw-bolts which unite to them the upper flanches of the lower pillars.

The second floor being formed as the first, a third set of pillars may be erected above it, in the same way, to support a third floor, and so on, successively, as many floors as are desired may be formed.

The principal frame work of the machinery, and the floors being thus erected, will be altogether independent of the walls, which the patentee directs to be built outside the whole, and independent of the floors, and so as only to assist in supporting the roof.

But to further economize, where extensive works of this nature are required, the patentee directs that the building or framing described shall be arranged in the external sides of a hollow square, having only walls of masonry externally, and entirely open to the inside area, in which way the floors will somewhat resemble the galleries of a play-house. The area in the middle is to be covered in above with a roof, having numerous or extensive sky-lights, to give light to the work-people at that side, while large windows in the external walls illuminate the building fully from the outside.

This last part of the plan, besides the saving of the expence of nearly half the walls usually employed for such buildings, for the much less cost of the additional roof, will also give great facilities to economize both in the warming and lighting the factory so formed, and will moreover render the inspection of the work-people more easy, and capable of being performed by fewer persons; for which latter design the patentee proposes to erect a building in the centre of the square, high enough for the purpose, from whence the overseers may observe every part of the works.

Besides the advantage of economy mentioned, this me-

thod of building will give greater firmness to the fabric, and make the whole frame more inflexible, so as to better resist the vibrations and concussions of the mill work, which are found to be very prejudicial to the operations of delicate mechanism.

The patentee does not confine himself to a quadrangular form for these buildings; but claims the use of any other right-lined polygonal figure also for this purpose, and only excludes those with curved sides, as right-lined figures are necessary in the shape of the floors, for the more perfect and economical arrangement of the frames of the machinery, so as to produce the best support of the floors, and the greatest stability for the fabric.

An arrangement of building, very similar to that above described, was proposed a few years since by Mr. Jeremy Bentham, to be used in the construction of prisons, and, as well as we can recollect, particularly for the Penitentiary at Millbank; but the patentee is the first, we believe, who has thought of applying the principle to factories, for which it would no doubt be well adapted, when they were sufficiently extensive; we mean merely as regards the form of the building, for the other parts of the plan are no doubt applicable to factories of all sizes.

We much doubt whether the mode of inspection proposed would be found adequate, particularly in a very large building, as it would be hardly possible to erect a central tower, so as to command the view of every part of it; to say nothing of the necessity of the inspector's passing in person to the place where he saw any thing amiss, which is not provided for by the patentee, though Mr. Bentham has well attended to arrangements for this purpose in his plan, which the circular shape of his building (that would not suit a lace mill, for the cause before stated,) much facilitated, as well as its size being upon a scale that would not answer for a factory.

There is one advantage of this mode of erecting a fac-

tory, which the patentee does not mention, and which would also assist in making it come cheaper than the common mode, which is, that in the latter the space between the floors, or the height of the rooms, must be considerable, to enable the work-people to have sufficient air for health, or to endure the smoke of the numerous lights necessary for such factories in winter; but in the method proposed by the patentee, the floors need not be more than seven feet apart, as the internal space above the central area will, in this case, yield abundant supply of air, and carry off the smoke of lamps, candles, or gas-lights, most effectually.

We doubt much whether external walls could be built to stand long, of the height usual for factories of the description mentioned, without having any ties or beams to connect them, or assist in withstanding the impulse of the elements as proposed by the patentee, as he expressly directs that the beams of the building are to be sustained alone by the internal framing, and have no connexion with the walls. But though experienced builders would not be easily induced to raise lofty walls in this manner, this defect in the plan is easily obviated, as the mode of erecting the internal framing gives facilities for forming cheap external fences against the weather, of various kinds; for example, a little addition to the iron framing proposed would form a sufficient support for the materials for this purpose, instead of requiring any from them; and as in buildings of the nature proposed, large windows would be required, and of course the spaces between them would be proportionably narrow, supposing those windows placed between iron pillars, somewhat similar to the others, and to be connected in like manner with the beams, the intervals between them being thus formed into square iron frames, might be filled up with single brick walls, secured by thin iron crossaties; or iron frames might be fitted into them, similar to sash frames, in the squares of which slates might be fitted and fastened in a similar manner to panes of glass, but with some cement cheaper than putty; for

which purpose Roman cement, as it is called, would answer very well; and if the inside of these frames were fitted up with slates likewise in the same manner, the air confined in the spaces between them and the external slates would form a sufficient barrier against changes of the atmosphere, to keep the building as warm as most walls would; since confined air is well known to be one of the best non-conductors of temperature.

Patent granted to the Rev. Moses Isaacs, *of Houndsditch, London, for improvements in machinery, which, when kept in motion by any suitable power or weight, is applicable to obviate concussion by means of preventing counteraction, and by which the friction is converted into a useful power for propelling carriages on land, vessels on water, and giving motion to machinery.* Dated Feb. 19, 1824.

The specification of this patent contains several different objects, some of which the Reverend Patentee has borrowed after the fashion of the Jews towards the Egyptians, and others by no means correspond to the intelligible part of the title.

The first of these, which comes under the first class, is a wheel with spring spokes, consisting of the fellies, rim, and nave, made as usual, but having arched spokes, formed of cane, steel plate, or any other elastic material, the inner extremities of which are confined between two hoops in the nave, while their other ends are let into the fellies.

To prevent a carriage being overthrown, the patentee directs an implement to be used, consisting of a metal tube, inclosing a rod having serrated teeth at its sides, which are acted on by a pair of spring nippers or catches. This is to be suspended in such a position from the upper part of the carriage, that when it inclines over above a certain degree, the rod will fall forward from the tube by its own weight; and being prevented from returning by the catches pressing on the serrated teeth, will act as a prop to prevent the carriage from any farther inclination, in the opinion of the Reverend Patentee.

The next article is a proposed arrangement of bevelled wheels and pinions, to transfer the friction of the axles, and make it *aid the propelling of the machinery*. Here lies the grand secret of the business, and that alone to which the title of the patent has any reference; but, unfortunately for the public, the Rev. Patentee has preferred to make his patent useless and untenable rather than communicate it; and actually gives no account whatever how said "bevelled wheels and pinions" are to be made to perform this miracle.

The third subject of the specification runs quite wide from the title, and is actually new. It is no less than a steam-engine, differing from all of that numerous race with which we are acquainted. It is to have three cylindrical boilers, ranged above a moveable furnace, the middle one of which lies higher than the other two, about the extent of its semi-diameter. It has also two working cylinders, one at each end of the beam, and two spring rods, for opening and shutting the valves, placed in a similar manner. The furnace or fire-place turns on two pivots, in the line of its longer axis, so as to incline at its upper part about 23 degrees with the horizon; and pipes passing from the boiler, most exposed to its heat by this position, to the working cylinder at the opposite side, elevates its piston, and forces thereby the other end of the beam to descend, which closes the valves of the steam pipe between that cylinder and the first boiler, by the spring rod at that side, and turns over the fire-place to the opposite boiler, which acts on the other cylinder in a similar manner; and so on alternately. But an extraordinary part of the contrivance still remains. Any one would suppose that the steam, after acting on the piston, would be either permitted to escape or to pass into a condenser. The patentee, however, has no idea of thus wasting this valuable agent, but directs that it is to pass off into the boiler next to it, which is the one from which the fire is turned off at its emission; and thus supposes that the difference of temperature caused in the boilers by the mere nutation of the fire-place in the small degree mentioned, will be sufficient to produce a

change of pressure on the opposite pistons, powerful enough to work the engine effectually.

Any thing new relative to our potent auxiliary, the steam-engine, deserves some attention; and the idea of operating, by causing a change of temperature in two boilers acting on the same engine, is certainly of this description: but we have good reason to suppose that for the common rate of working, this change could not be effected sufficiently speedy by any means of withdrawing or screening the fire from the boilers. If engines could be applied to any useful purpose, which would make an alternation of the piston only once in ten or twelve minutes, perhaps the patentee's plan might be made to act, but by no means in the economical mode he thinks; for in this way he loses the heat of his steam through the sides of the boiler, which is the valuable part of the steam (and, in fact, it is by the alternation of this loss in the two boilers that his engine could work at all), and only saves the water, which, except for locomotive engines, is of no value, and for them only as its expenditure makes a greater weight necessary to be carried.

Of the prop to prevent carriages being overthrown, we will only observe, that as soon as it touched the ground it would be either broken or tumbled over by the progressive motion of the carriage, there being nothing attached to it to prevent this effect.

Of the bevelled wheel and pinion apparatus we will reserve our opinion till the patentee pleases to explain to the public how they are to perform the purpose for which he designs them, and thus fulfil the proviso of his patent, which relates only to this part of his specification, as its title will abundantly prove.

Lastly, of the wheels with spring spokes we must observe, that the Reverend Patentee has not only borrowed the invention, but part of the description of it given by the real inventor.

In Vol. XVII. of the second series of the Repertory of Arts, &c. there are some observations on wheel carriages, roads, and the draft of horses, communicated by Mr. J. W. Boswell to a Committee of the House of Commons, appointed to take these subjects into consideration, which, with several other similar papers, were ordered to be printed by the House, in 1809. In the plate accompanying these observations will be found a figure of this very wheel with spring spokes, and in the description of it the very same directions for fastening one end of each of the spokes to the nave by two hoops, and their other ends to the fellies, that Mr. Isaacs gives; and also the following account of the advantages of this species of wheel, great part of which the Rev. Gentleman has copied into his specification. In the third paragraph of the section on the spring wheel, in Mr. Boswell's paper, it is stated that "the spring wheel would possess the very singular property of preventing all loss of momentum from common obstacles and ruts; for when the rim struck an obstacle, the re-action, instead of destroying part of the momentum of the carriage, would only cause the spring spokes to bend towards it; and when the axle was past the obstacle, the recoil of this bending, which would then take place, would add as much to the velocity of the carriage as the bending before took from it."

This gross plagiarism, to say no worse of it, is not very creditable to the Rev. Patentee, and certainly would merit more reprehension if the very act did not bring its punishment along with it, by rendering his patent untenable. Indeed it is very doubtful, even without this, if a patent, where a specification differs so widely as Mr. Isaacs' does from the title of the patent, and containing matter so totally unconnected with it, could be sustained in a court of law; the title of a patent, and the exact accordance of the specification to it, being points of very great importance to its validity.

Patent granted to HENRY R. PALMER, *of Hackney, Middlesex, Engineer, for improvements in the construction of rail-ways and tram-roads, and of the carriages to be used on them.* Dated November 22, 1821.

MR. Palmer's rail-way differs from those in common use, in consisting of one rail only, elevated on posts, some height above the ground. On this rail carriages of a peculiar construction are to be moved without upsetting, by having the centre of gravity of their loading suspended below the line of support, or rail. They are to have but two wheels, placed 3 or 4 feet apart on the rail, whose axles are to support a light iron frame, from which the loading is to be suspended in two cases or packages, one at each side of the rail, in such a manner, that if a little more weight should be in one than in the other, it may not materially impede the progress of the carriage; and they are drawn forward by the horses, with ropes of 20 or 30 feet in length, as boats are on canals. The posts, when made of cast iron, are to be constructed in the form of two planes, crossing at right angles, similar to the pillars of some of the gas-lamps, with a projecting horizontal flanch in the middle of their length, and tapering somewhat in both directions from thence; this flanch is to lie at the surface of the ground, when the post is fixed in its place, all below it being buried in the earth; at the top of each post a slit, or fork with parallel sides, is formed in the direction of the rails, the extremities of two pieces of which rest within it, they being formed with vertical scarfed joints there for that purpose, and having beneath them wedges placed, by driving which the level of these rails can be adjusted more exactly. When the pieces of the rail exceed a certain length, they pass through the tops of more of the posts, but in all cases are placed there as described. To fix the posts firmly in the ground, a hole is dug, of a proper depth, depending on the nature of the soil, and its bottom rammed firm with a conical rammer, by an engine like a small piling engine; some broken stones, such as are used for making roads, are then thrown in, and rammed up to the place intended for the bottom

of the post, which is then put into the hole, and more of the broken stones thrown in, and rammed tightly about its sides, which are cast of a serrated or notched shape, the better to adhere to the stones; and this process is continued till the hole is filled up. The posts must vary in height, according to the undulations of the ground, and their distances must depend on the thickness of the rails, though the patentee seems to prefer distances of ten feet.

Mr. Palmer asserts that this arrangement of the rail will cause a great saving in embankments, bridges, culverts, and drains, and that the carriages will be moved on it with less friction and resistance than on the rail-ways hitherto in use; averring that a horse can draw a load on it, when level, of 33,750 lbs. $2\frac{1}{2}$ miles in an hour, which on the best performing edge rail-way that he had heard of (that near Newcastle-on-Tyne) could move only 17,773 lbs. at the same rate.

We should be greatly at loss to account for the superiority of performance just mentioned of Mr. Palmer's rail-way, and even to suspect exaggeration, could we not see in the nice adjustment of Mr. Palmer's apparatus, and in his curious contrivance to lessen the friction of his wheels, (which we are, by the by, inclined to attribute to its bringing a larger surface of the axle and hollow box of the nave into contact, instead of the oil being prevented by it from assuming the shape of a wedge, as Mr. Palmer asserts,) somewhat to justify the validity of the experiment; to this we have to add, that the shape of the surface of this rail, which is the segment of a circle, and the hollow rim of the wheel being also of the same circular form, will at *first* give a great superiority to the performance of the apparatus, which the power of adjusting the level, or inclination of the rail by the wedges, to unusual nicety, must greatly assist. But as all these circumstances are equally applicable to the common double rail-roads of the edge form, we think that farther trials than those made previous to the publication of his book will be necessary, impartially conducted, with wheels, axles, and both parts of the ap-

pattern, equally good and perfect in the other species of rail-roads, before the question can be fairly decided.

That the form of the surface of the rail and rim of the wheels, being segments of circles, will at *first* much facilitate the draft, as we have just stated, depends upon the well-known geometrical problem, that a circle described within another circle can only touch it in a point; therefore as long as these forms continue perfect, the lateral friction of the projecting part of the rim of the wheel against the side of the rail will be avoided, and so long will a great source of resistance, which is experienced in other rail-roads, be overcome.

The Penrhyn rail-way, which was originally formed in this manner, had at *first* all the advantages stated; but according to the authority of Mr. Benjamin Wyatt (for which see Repertory of Arts, second series, Vol. III. p. 285) the two circular surfaces of the rail, and of the wheel's rim, as they wore, excavated the latter so much, and caused it to fit so tight, as to occasion much friction, and make it necessary to change the wheels so often, that another form of rail and wheel became necessary; from which it follows, that *time* is needful in experiments of this sort as much as any thing else, and that it is requisite new kinds of rail-ways should be in perfect operation for a reasonable period, before their superiority can be allowed.

We consider Mr. Palmer's rail-way to be a very ingenious invention, and think his publication on the subject contains much useful information on rail-ways in general, though we cannot agree with him in his statements of its advantages. A rail-way of Mr. Palmer's construction has been erected at Cheshunt, near Waltham, to carry bricks from Mr. Gibbs's fields, about a mile, to the river Lea: it is constructed of wood, with posts about five feet high, and ten feet apart, as we are informed, and has the surface of the rail covered with an iron plate. Nothing at present can be learned from this experiment, but that the plan is feasible, which we never doubted; but for the reasons

stated we must wait for the effect of wear, and of the weather upon it, before we can decide how far the posts will maintain their upright position, and the rails their level, the first of which points we do not think sufficiently provided for by the patentee. In point of expence, a wooden rail can be no guide for those to be made of iron; and when formed of this latter material, we think the patentee deceives himself in supposing that his rail-way can be made cheaper than a common double one; for, supposing his made with rails of the same strength as they are, and of course requiring supports, as they do, at every three feet, or thereabouts, now his pillars being three feet at least above ground, and as much more below the earth, (according to his drawings) and requiring to be of considerably greater substance, it is evident that they will take at least double the weight of iron for their construction, which would be necessary for the second rail, saved by his plan; and if, as he proposes, they be set farther asunder, nothing will be gained in this respect, since the rails then must be made so much stronger in proportion; (to which must be added, that they must in all cases be made of double the strength of common rails, one of them having to sustain the load of two of these,) and as for the lengths of ten feet between the posts suggested, their weight, to carry the usual loads, must be so much greater than that of any now used, that we much doubt if any of them, of iron solely, will ever be constructed.

That erecting numerous lofty pillars of iron, as proposed by the patentee, can cost less than embankments of earth, (in general the cheapest mode known of raising an elevated surface), we cannot in any respect credit, and can still less give faith to, the advantage of making rail-ways of this kind ten feet high above the level of the earth, advocated by some of his friends.

We have further to remark, that loads carried as designed on this rail-way will, from their pendulous arrangement, be extremely liable to be knocked against the posts

in high winds, to the great damage of the goods carried, as well as the obstruction of their conveyances, which, in case of a storm, blowing across the rail, may be sometimes so great, as to render the rail-way totally impassable for the time of its duration.

The injury from unequal loads at the two sides of the carriages, we do not think would be found so slight as asserted by the patentee, who states that all acquainted with *geometry* must be of his opinion on this point. Now in the first place, it remains with him to show what problem of geometry can be brought to bear on the question, and that he has not used the word geometry here in the vulgar sense for equilibrium; and, in the next place, to point out how he prevents the danger incurred by the oblique position of the wheels, which this must occasion, of the carriage being entirely dismounted. The rods, which connect the loads with the axles, being jointed to them so as to be at right angles to them in all their oscillations, (which we suppose is what is meant by their being *inflexible*,) though it will, when the centre of gravity of the load is placed below the rail, keep them from tumbling off directly, yet will not prevent the risk of the accident mentioned, while it will increase that of their being knocked against the posts.

In conclusion, were we obliged to decide on the question in the present stage of this experiment, which, however, we do not wish to do, we would say that the plan of single rail-ways should be confined to that species of them constructed at Cheshunt, as they would be much too costly if formed of iron, for the reasons before stated. The great defect of the wooden framing would be its want of durability, and the expence of its repairs, particularly in the posts, which would be extremely liable to rot at the level of the ground; for which, in order to show that we have no ill will to the plan, from being able to see its defects, we will point out a remedy, which will make them more durable, and facilitate the repairs,—which is, to have a pare cast iron sockets, two or three feet long, placed so as

to occupy this portion of them, let down firmly for half their length, on the lower part of the posts, secured in the earth as before described, and the other half forming a receptacle for the bottom of the upper portion, which should be formed so as to project a little beyond it at every side, to throw off the rain; and in order that the fitting between the wood and iron socket might be more perfectly tight, the wood in this part should be previously compressed by screws, a method already practised to great benefit in the preparation of staves for casks; to facilitate which process we have advised the sockets to be made square, instead of cylindrical, a form which, in other respects, might at first appear more adviseable.

LIST OF NEW PATENTS.

JEAN JACQUES SAINTMARC, of Belmont Distillery, Vauxhall, Surrey, distiller, for improvements in the process of, and apparatus for, distilling.—Dated June 28, 1825.—Six months to enrol specification.

DAVID REDMUND, of Agnes Circus, Old Street Road, Middlesex, engineer, for improvements in building or constructing ships, houses, and other buildings.—Dated June 28, 1825.—Six months to enrol specification.

GEORGE TOMPSON, of Wolverhampton, Gent. for an improvement in the construction of riding saddles.—Dated June 28, 1825.—Six months to enrol specification.

JOHN HEATHCOAT, of Tiverton, lace-manufacturer, for improvements in the method of manufacturing of thrown silk. Dated July 6, 1825.—Six months to enrol specification.

WILLIAM HEYCOCK, of Leeds, woollen cloth manufacturer, for improvements in machinery for dressing and finishing of cloth.—Dated July 8, 1825.—Six months to enrol specification.

JOHN BIDDLE, of Donnington, in the county of Salop, glass-manufacturer, for a machine or combination of machinery for making, repairing, and cleansing roads and

pitch, which machinery, or parts of which machinery, is or are applicable to these and other useful purposes.—Dated July 8, 1825.—Six months to enrol specification.

Montague [illegible] Salmon, of Brampton Hall, Wrangford, Suffolk, Lieutenant in the Navy, for improvements for the purposes of setting, working, reefing, and furling the sails of boats, ships, and other vessels.—Dated July 8, 1825.—Two months to enrol specification.

William Furnival and John Craig, both of Anderton, Chester, salt-manufacturers, for improvements in the manufacturing of salt.—Dated July 8, 1825.—Six months to enrol specification.

John Day, of Nottingham, and Samuel Hall, of the same place, lace-manufacturers, for an improvement on a pusher twist or bobbin-net machine.—Dated July 8, 1825. Two months to enrol specification.

Walter Hancock, of King-street, Northampton-square, Middlesex, jeweller, for an improvement or improvements in the making or constructing of pipes or tubes for the passage or conveyance of fluids.—Dated July 16, 1825.—Six months to enrol specification.

William Hirst and Henry Hirst, of Leeds, manufacturers, for improvements in the art of scribbling and carding sheep's wool.—Dated July 16, 1825.—Six months to enrol specification.

Henry Hirst, manufacturer, and George Bradley, machine-maker, both of Leeds, for improvements in the construction of looms for weaving woollen cloths.—Dated July 16, 1825.—Six months to enrol specification.

Thomas Wolrich Stansfeld, merchant; William Prochard, civil engineer; and Samuel Wilkinson, merchant, all of Leeds, for improvements in looms, and in the implements connected therewith.—Dated July 16, 1825.—Six months to enrol specification.

Thomas Mussehohite, of Devizes, saddler, for improvements in the manufacture or construction of collars for horses or other animals.—Dated July 16, 1825.—Two months to enrol specification.

Marc Isambard Brunel, of Bridge-street, Blackfriars, London, Esq. for certain mechanical arrangements for obtaining powers from certain fluids, and for applying the same to various useful purposes.—Dated July 16, 1825. Six months to enrol specification.

Thomas Sitlington, of Stanley Mills, Gloucestershire, engineer, for improvements in machinery for shearing or cropping woollen or other cloths.—Dated July 16, 1825. Six months to enrol specification.

Joseph Farey, of Lincoln's Inn Fields, Middlesex, civil engineer, for an improvement in lamps.—Dated July 16, 1825.—Six months to enrol specification.

Thomas Robinson Williams, of New Norfolk-street, Strand, Middlesex, Gent. for an improved lancet.—Dated July 16, 1825.—Six months to enrol specification.

Thomas Cook, of Upper Sussex Place, Kent Road, Surrey, Lieutenant in the Navy, for improvements in the construction of carriages, and on harness to be used therewith, whereby greater safety to the persons riding in such carriages, and other advantages, will be obtained.—Dated July 16, 1825.—Six months to enrol specification.

Joseph Cheeseborough, of Manchester, merchant, for a method of conducting to and winding upon spools or bobbins, rovings of cotton, flax, wool, or other fibrous substances. Communicated by a foreigner.—Dated July 16, 1825.—Six months to enrol specification.

William Hirst, Gent. and Joseph Carver, cotton spinner, both of Leeds, for an apparatus for giving a new motion to mules and billies.—Dated July 16, 1825.—Six months to enrol specification.

John Palmer de la Fons, of George-street, Hanover-square, dentist, for an improvement for extracting, and method of fixing, teeth.—Dated July 16, 1825.—Six months to enrol specification.

Jonathan Downton, of Blackwall, Middlesex, shipwright, for improvements on machines or pumps.—Dated July 19, 1825.—Six months to enrol specification.

THE REPERTORY OF PATENT INVENTIONS, &c.

No. III. SEPTEMBER, 1825.

Specification of the Patent granted to JOSEPH SPENCER, *of Belpar, Derbyshire, Nail-manufacturer, for certain improvements in the construction of furnaces or forges for the preparation of iron or steel, and for the process of manufacturing of nails and other articles from the said materials.* Dated April 7, 1824.

TO all to whom these presents shall come, &c. *Now know ye,* that in compliance with the said proviso, I, the said Joseph Spencer, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained by the following description thereof, (that is to say):—The furnace or forge which I have used for the making of nails (which is also calculated for other small articles), is an elevation of brick-work of a circular form, four feet in diameter, and three feet in height, having a circular opening for the fire in the centre, and communicating on the ground with the outside by an aperture, for the purpose of removing the dust and dirt that may fall through the grate.

When the brick-work is carried up 20 or 24 inches, the circular opening in the inside is to be covered with a very

fine grating of cast iron, the bars being only a quarter of an inch apart, and the grating of sufficient dimensions to form a bottom to the fire-place. The brick-work is then to be raised three courses, using either common or fire bricks round the internal opening, inserting the tue iron for the bellows, and leaving an aperture for the bellows pipe. The whole is then covered with a flat circular cast iron plate, in one, two, or more pieces, having a rim round the external edge, to the depth of six inches, to hold the fuel for the occasional supply of the fire. This plate has an opening in the centre, sufficiently large to take a frame which is placed immediately upon the fire bricks, which frame consists of a ring of cast iron, flat upon the bottom, one and a half inch thick on the outside edge, and bevelled to the thickness of half an inch upon the inner edge. The external diameter of the ring is 20 inches, and the opening of the inside 14 inches. To this ring are fixed, in a triangular position, three pillars, nine inches high, to support another ring, of the same dimensions and material as the ring above described, about half an inch in thickness, with a small rim or selvage on the outer edge, to admit of the brick work of the chimney being placed within it. The brick-work of the flue of the chimney is then carried from this upper plate or ring to the height required. There are also inserted in the brick-work three troughs of cast iron, for the purpose of holding water.

The bellows are suspended upon a frame, in the situation that may be most convenient, and are worked by a double lever united with a bow, and passing round the chimney so as to be within reach of every one of the workmen who may be employed round the furnace; and in the making of nails six workmen may be very advantageously employed at the same time, who will keep up a continual blast from the bellows, so that the fire will be at all times in a bright and vivid state.

Now though I have adopted a circular form and brick-

work in the forge or furnace described, I do not confine myself to the circular form, or limit myself to the dimensions here given, as any other form or size may be used, better suited to the size and shape of the article to be manufactured. Also stone may be used in the elevation, or it may be made altogether of iron, or partly of iron, stone, or brick-work.

In the preparation of iron, or steel, for the purposes of manufacturing nails or other articles, I use a certain portion of coal, purified as far as possible by calcination from sulphur or other noxious matter, and a certain portion of wood charcoal. The proportions I have adopted are, one-fourth part by measure of wood charcoal, and three-fourths of prepared or purified coal; but these proportions may be varied according to the nature of the coal, and the metal to be wrought.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

There are many novel features in this invention which do not, on the perusal of the specification, strike the reader. Nothing is represented to his mind but bricks, mortar, and iron, in the form of a forge, with which substances forges have been erected since the days of Zubal, while, to the operative man, who has to preserve the quality of pure iron uninjured, this invention presents a most invaluable acquisition. In no other forge (excepting a hollow fire) can pure wood charcoal be used; no other forge is constructed without a back; no other forge has a grating to keep the fire clean, and prevent the accumulation of clinker; no other forge will admit of the same number of workmen being employed at the same time; no other forge can be erected at so little expence.

Specification of the Patent granted to JACOB PERKINS, *of Fleet-street, London, Engineer, for improvements in the mode of heating, boiling, or evaporating by steam, of fluids, in pans, boilers, or other vessels.* Dated May 17, 1823.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said Jacob Perkins, do hereby declare the nature of my said invention by the following statement thereof, that is to say:—Whereas I, the said Jacob Perkins have heretofore obtained His present Majesty's letters patent under the Great Seal of Great Britain, bearing date at Westminster, the 10th day of December, in the third year of His reign, for certain improvements in steam-engines. (Published in our 43d vol.) And whereas a specification of the said patent was enrolled on the 10th day of June, 1823, in the proper office for that purpose; and whereas the said specification did contain a description of a generator, such as is hereinafter alluded to. Now the nature of my said invention doth consist in pipes, hollow cylinders, or other the like apparatus, projected from such generator as aforesaid, into fluids, which apparatus is to be filled with steam from such generator as aforesaid, for the purposes of heating, boiling, or evaporating the said fluids in pans, boilers, or other the like vessels; and which apparatus is to be so arranged with valves and a forcing pump, as to return the water produced by the condensation of the said steam into such generator as aforesaid; and which apparatus is to be so arranged also, that the said steam and water is always under mechanical pressure. And in further pursuance of the said proviso, I do hereby describe a manner in which my said invention may be performed, by the following description thereof, reference being had to the drawings and figures annexed, that is to say:—

DESCRIPTION OF THE DRAWING. (See Pl. VI.)

Fig. 1 is a sectional elevation of an apparatus on the principles of my said invention: A is the generator described in the specification of my said patent for certain improvements in steam engines: B is a forcing pump: C C C is a pipe or hollow cylinder, opening to and projected from the upper part of the generator at D, and opening to and projected from the lower part of it opposite the part marked E, which will be more clearly shown when describing the next figure: F is a pipe leading from the pipe, C, to the forcing pump: G is a valve, and H is a boiler, pan, or other vessel, supposed to contain fluid. In this application of the generator, J acts only as a safety valve. Fig. 2 is a plan of the apparatus described in fig. 1, and shows more clearly the particular process that is effected by it. The parts in this figure which are similar to those in fig. 1 are marked with the same letters: K is a valve not shown in fig. 1, and L is the particular part of the generator at which the end of the pipe, C, hereinbefore described as being opposite the part marked E, opens into the generator. It will be seen by this arrangement, that steam being received into the pipe, C, from the generator, at D, it passes into that part of the pipe which is projected into the vessel, H, containing the fluid to be heated, there the steam becomes condensed, and collects in the form of water at the neck of the valve, G. When the handle of the forcing pump is raised, the valve, G, opens, and the water fills the remainder of the pipe, C, and the pipe marked F, the valve, K, remaining shut. When the handle of the forcing pump is pressed down, the valve, G, shuts, and the water being thus prevented from returning into that part of the pipe, C, which is in the fluid, forces open the valve, K, and finds its way into the generator again at L. Now whereas the exact dimensions and proportions of my said invention are not material, but those represented in the drawing annexed are what I consider the best, as far as

regards the parts immediately connected with the generator, for those parts which are introduced into the fluids which are to be heated by them, must be varied both in size and shape, according to the various situations in which they are to be applied. And whereas I have herein described a generator for the purpose of elucidating, but which forms no part of my present invention; but such an apparatus as hereinbefore described, for heating, boiling, or evaporating by steam, fluids in pans, boilers, or other vessels, which said apparatus doth consist, as far as I claim any novelty therein, of pipes, valves, and a forcing pump, arranged as aforesaid, being, to the best of my knowledge and belief, entirely new, and never before practised in these kingdoms, I do hereby declare this to be my specification of the same, and that I do verily believe this said specification in all respects, fully, and without reserve or disguise, doth comply with the proviso in the said hereinbefore in part recited letters patent of the seventeenth day of May, contained. And lastly, I do hereby claim to maintain an exclusive right and privilege to my said invention.

In witness whereof, &c.

Specification of the Patent granted to HUMPHRY JEFFREYS, *of the city of Bristol, Merchant, for an improved flue or chimney for furnaces and other purposes.* Dated October 7, 1824.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said Humphry Jeffreys, do hereby declare the nature of my said invention to consist in a flue or chimney, so constructed as to cause an artificial draught in the same, and to condense the smoke and other matters evolved in such manner as to prevent their escape into the atmosphere. And in further compliance with the said proviso, I, the said Humphry Jeffreys, do hereby describe the manner

in which I perform my said invention, by the following description thereof, reference being had to the drawing annexed, and the figures or letters marked thereon, that is to say :—

DESCRIPTION OF THE DRAWING. (See Pl. VI.)

The figure 3 in the drawing represents a section of one of my said improved flues : B represents the commencement of an ordinary flue, proceeding from any common furnace, the top of which is closed at C, sufficiently air tight to prevent the escape of any smoke. This part of the flue I shall call, by way of distinction, the smoke passage : E is a second passage or shaft, which I call the condensing shaft, and may be built either beside the smoke passage, the central partition wall being common to both, or at any convenient distance from it, provided always that the aperture of this shaft be perpendicular in its whole length. At the top of the condensing shaft, E, is a cistern, F, which must receive a constant supply of water from some convenient source. The bottom of this cistern must be perforated with small holes, so as to create an artificial shower when supplied with water ; and the said supply of water must of course be regulated so as to meet the waste occasioned by the said holes. At the bottom of the shaft, E, is an opening or passage, G, by or through which the fallen water, condensed smoke, and all other matters which have descended, pass into a tank or drain, as the case may be, for the purpose of conveying the same to any considerable distance. In this figure or drawing the condensing shaft is represented as separated from the smoke passage, and D represents a communication passage, leading from the top of the smoke passage to the top of the condensing shaft, into which it should enter just under the cistern, F. This communication passage should in all cases be of as large dimensions as the smoke passage. It should here be observed, that when the smoke passage and the condensing shaft have one common wall to divide them, an aperture in the said wall, corresponding to that

at H, in the drawing annexed, will suffice, without any communication passage. Now by the foregoing arrangement of flue or chimney it will be seen, that if smoke rise from the furnace into the smoke passage, and thence proceed into the condensing shaft, and if water be admitted into the cistern, and suffered to pass through the said holes in the bottom of the said cistern, down the condensing shaft, a draught will be occasioned that will draw the smoke and other matter evolved from the furnace, from the smoke passage into the condensing shaft, where it will be condensed and carried down with the falling water into the tank or drain below, as hereinbefore described; and such an arrangement of flue or chimney, for the purposes aforesaid, and effecting the draught and condensation aforesaid, in manner aforesaid, being, to the best of my knowledge and belief, entirely new, and never before used in these kingdoms. I do hereby declare this to be my specification of the same, and that I do verily believe this my said specification doth comply in all respects, fully, and without reserve or disguise, with the proviso in the said hereinbefore in part recited letters patent contained; wherefore I do hereby claim to maintain exclusive right and privilege to my said invention.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

When the mode of condensation described in the foregoing specification first occurred to me, I had been looking into Bishop Watson's Chemical Essays, and was seeking a remedy for the various evils which result from the process of smelting ores, especially those of lead and copper.

It is well known what very pernicious effects are produced by the arsenical, sulphurous, and metallic vapours, which issue with the smoke from the furnaces constructed for the purpose in question, spreading their baneful influence to a very great distance. At Swansea, for instance, the face of the country, in a circuit of more than three

Fig. 1.

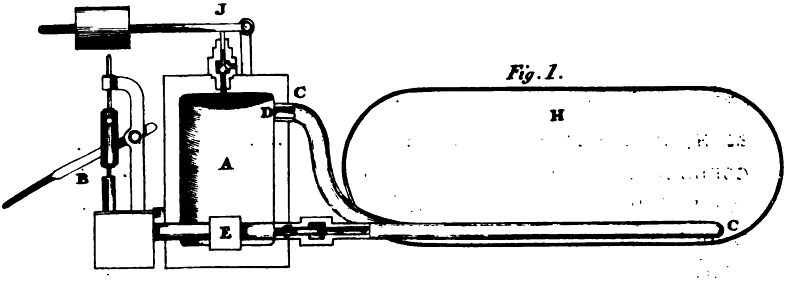
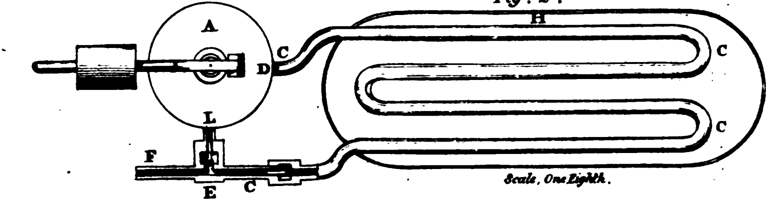


Fig. 2.



Scale, One Eighth.

Fig. 3.

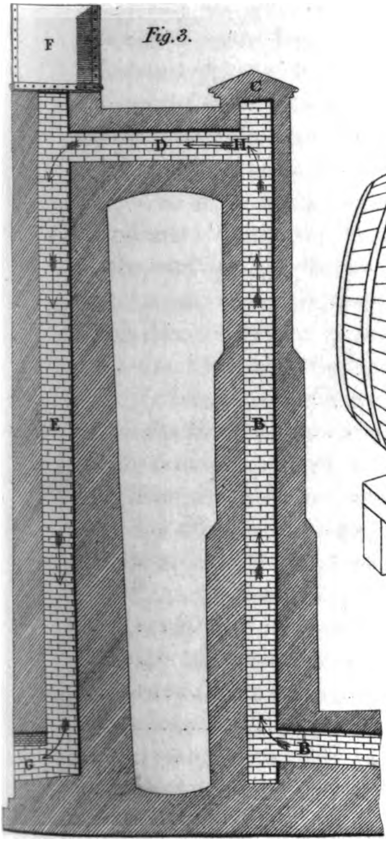
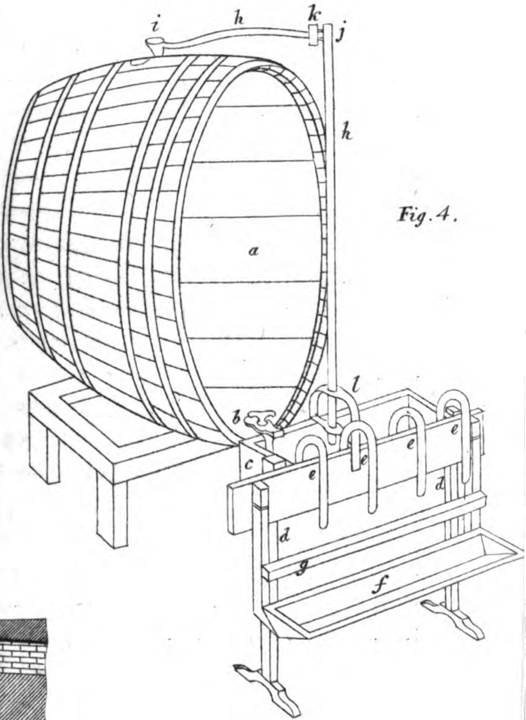


Fig. 4.



miles from the works, bears ample testimony of the deleterious effects, which cause disease, and often loss of life to the inhabitants and to cattle; vegetation being, at the same time, almost utterly destroyed.

The means by which I could thus effect condensation having presented themselves to my view, it became necessary that I should be circumspect when taking into consideration whether there were any and what obstacles to its being carried into active operation; but I have discovered none that are insurmountable. I admit, that in many cases the procuring the necessary supply of water may be attended with difficulty, as well as considerable and permanent expence; but these, of course, will vary according to local circumstances, and, in the most unfavourable, can bear no proportion to the advantages to be obtained. Will the preservation of life, whether of human beings or cattle, be of no estimation? Would no value attach to the bringing a wide district of sterile country into a state fit for cultivation? Are no profitable results to be derived from the condensation of all the sublimed metals, sulphur, and other valuable matters, which, by the old system, do so much incalculable mischief? I trust those whose interests are so deeply concerned, will not fail to give these questions their serious attention.

In the Chemical Essays I have alluded to, the Bishop says, it has been computed that 10,000 tons of lead ore are annually smelted in Derbyshire; and if means could be invented of saving the sulphur from this quantity of ore, which he considers to be equal to one-tenth of its weight (but he admits at the same time that it unquestionably yields more), Derbyshire alone would furnish 1000 tons of sulphur, which he values at 15,000*l.* Further on, he adds, "It is not easy to determine with precision the quantity of lead which is sublimed; a general guess, however, may throw some light on the subject. It is usual at a smelting-house to work off 60 cwt. of ore every 24 hours, which yields about 40 cwt. of lead; in addition to which, he calculates that 3 cwt. more is sublimed, which, *if it*

could be collected, would make an annual saving at each smelting-house of above 50 tons."

In his eighth essay, Vol. III. he submits to the consideration of the lead smelters, whether they would not derive great advantage from substituting an horizontal chimney, of 2 or 300 yards in length, in place of the perpendicular one commonly in use. If he had been aware that horizontal chimnies might be extended to any distance without weakening the draught of the furnace, he certainly would not have failed to have recommended an improvement fraught with so many lucrative advantages. By the plan I offer, instead of lessening the draught, the means of increasing it, and of regulating it to any extent, and with the greatest precision, are obvious, and easily attained. If the chimney were a mile or more in length, horizontal, or tortuous, it matters not in what line of direction it may run, still the force of draught would be great as could be wished, provided that ultimately it be made to communicate with a condensing shaft, constructed in the manner I have described in my specification.

By this process, not only much valuable matter, but, literally, the whole, which by the old method is not only lost, but productive of such lamentable consequences, may, to a certainty, be preserved; for all the smoke, sublimed metal, and noxious vapours combined therewith, will either be deposited, as they part with their heat, in the great length of passage; or, if any portion of it when arrived at the extreme end should be still volatile, that also would be condensed and carried down by the shower of water.

Having asserted that the force of draught may be increased to any extent, it may be proper that I enter into some detail of the several causes which, both separately and collectively, tend to augment it; and I hope that in so doing I shall stand excused, since I do not expatiate on the subject with any expectation that I shall add to the stock of knowledge which others possess, but it is important to my object, that in taking a cursory view, as

may probably happen, those points should not be overlooked which, on closer attention, would not fail to be duly appreciated.

It is well known that air and water powerfully attract each other, and in the specification it is stated that the shower of water which falls down the condensing shaft "must be constant." Being so, it must uninterruptedly carry down with it all the air it comes in contact with, and a vacuum would be left behind, were it not that other air rushes in to fill up the vacant space. But in what direction can it find admission, unless it be through the furnace?

There is another cause of draught, connected with the foregoing, which affords a material increase,—that air, which has passed through the furnace, and all the various matters which the fire has rendered volatile, have their volume expanded in proportion to the quantity of heat they contain. The bulk of this is again reduced when it is met by the shower of water, and again a vacancy would be created, were it not that it is instantly filled by the admission of atmospheric air, which, in like manner, must pass through the furnace.

There is a third cause of draught, which is, in my estimation, of most essential importance, particularly where a great force is required. All heavy bodies (and water is one) fall with a velocity which does not continue at one uniform speed, but which increases as the squares of the times taken up in their descent. For instance, a heavy body falls through a space of $16\frac{1}{2}$ feet in the first second of time; but in two successive seconds it falls through a space of 66 feet, for the square of 2 is 4, and $16\frac{1}{2}$ multiplied by 4, is equal to 66. Here then it is clearly shown that the means are in our power (and they are simple too) of raising the force of draught to an extent that appears to have no limits; for whether, on the one hand, the condensing shaft be increased in size, by enlarging its area, or otherwise by adding to its height, the desired object will be obtained; but where an intense rapidity of current

may be required, the combination of increased area and height, with the shower of water duly proportioned to the purposes required, cannot fail to produce a draught that I am confident was never yet experienced from the operation of any air or blast furnace. It remains, however, to be proved how far this plan can be usefully applied to smelting of iron; but I trust it will not be long before a trial of it be made, since several scientific men, conversant with that line of business, have given opinions which are very encouraging.

There may be some difficulty in introducing this mode of condensation into such steam vessels as are already fitted up; at any rate, the necessary alterations would be found expensive; but the obstacles cannot be insuperable, and, if once overcome, the advantages to be derived are very great, and sufficiently obvious. In the first place, that odious nuisance, the iron chimney, which in most vessels is 40 feet high and upwards, may be entirely done away with; and that which would be required to give sufficient draught to the fires, and complete condensation to the smoke, may be enclosed in an ornamental casing, not exceeding the height of 10 feet, and probably not so much; and if the condensed soot and water be discharged within the casing of the paddle wheels, nothing offensive would be visible. Numerous will be the advantages when this improvement is brought to bear. All the insufferable annoyance from smoke will cease, and the rolling of the vessel, occasioned by the great weight and height of chimney, will no longer be felt; nor would the vessel's way through the water be retarded when working against a head wind, if the extent of surface of this great chimney be no longer opposed to it. The vessel itself would, in all respects, have a very different appearance. Cleanliness and comfort, both within and without, would be substituted for misery and filth, and gay streamers and white sails would afford a gratifying contrast to the black canvass and dingy colours which now disgust the sight.

Admitting the different statements I have given respect-

ing the means by which a great force of draught may, when required, be obtained, and complete condensation of smoke, &c. be effected, to be correct; and having shown (I hope satisfactorily) that in situations where circumstances are favourable, smoke may be carried off by drains or passages under ground to an indefinite distance; or, otherwise, immediately and totally condensed, without causing the slightest inconvenience or injurious effect, may I not, without presumption, indulge the flattering expectation that the time will arrive, and at no very distant period, when the lofty chimnies which are now so generally used as a necessary appendage to furnaces of almost every description, will be removed. Manifest advantage has certainly been derived from the use of them, yet still they only lessen, they cannot effectually remedy the existing, evils. I have heard of one chimney at Kidderminster which, if I mistake not, is upwards of 100 feet high; but great as this elevation may be, some unburnt matter, much ash, and all the noxious vapours issuing from the coal, must, notwithstanding, pass into the atmosphere, and must descend to the earth. That the evils produced are still very sensibly felt, and more especially at all our great factories of woollen, cotton, and other fabrics, is amply testified by the new chimnies thus towering, progressively, more and more above those of long standing.

I think it will be recollected by many that Mr. M. A. Taylor expressed, in the House of Commons, a confident assurance, that at no great distance of time London would be as free from smoke and soot as Paris. Without claiming to myself any farther merit, may I not be allowed to ask, whether my plan does not hold out some useful hints towards forwarding his views?

Specification of the Patent granted to THOMAS MASTERMAN, *of the Dolphin Brewery,* 38, *Broad-street, Ratcliffe, Middlesex, Common-brewer, for an apparatus for bottling wine, beer, and other liquids, with increased economy and dispatch.* Dated February 19, 1825.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. &c. *Now know ye,* that in compliance with the said proviso, I do hereby declare that my said invention, and the manner of making and using the same, is described and ascertained by the drawing in the margin hereof, and by the following explanations thereof, and by the descriptions and observations hereinafter contained, (that is to say) :—

I assume that the liquid I am about to bottle is contained in a cask, well closed, placed on its side, and in a situation proper for bottling the liquid in the usual manner. (It will be seen that the liquid may be contained in any other close vessel, rendered air-tight.)

In the following description, the letters refer to the figure in the margin. *a* (fig. 4, Pl. VI.) is the cask. I drive into the proper hole a cock, *b*, having a nozzle of about four or five inches in length, and having a bore or passage of equal or greater area than the sum of the areas of the whole of the syphons (after-mentioned) added together: *c* is a trough; its dimensions are about 14 inches in length, six inches in breadth, and four inches in depth. It is attached to the frame, *d d*, in such a manner, that its distance from the foot thereof may be increased or diminished at pleasure: *e e e e* are four metal syphons, having each leg of nearly equal length. One leg of each is fixed to the inside of the front of the trough (or that side of it farthest from the cask), the ends being within one inch of the bottom of the trough. The other leg is outside of the trough, and about three inches apart from its said front. The crowns of the syphons are about three inches above the upper edge of the trough: *f* is a trough to catch the liquid that

may be spilt while changing the bottles. It is also attached to the said frame, so as to move up or down: *g* is a rail attached to trough *f*, so that it moves with the same trough. Its use is for the bottles to stand on while they are filling. As I shall not have occasion to mention trough *f* again, trough *c* must be understood when I afterwards mention "the trough:" *h h* represents what I designate "the air tube;" the inner diameter of the perpendicular part thereof may be more, but ought not to be less than one inch; the inner diameter of the horizontal part need not be greater than about one quarter of an inch. The cross-piece, *i*, is of solid brass, bored only so high as just to pass the end of the tube soldered into it. The horizontal part of the tube is made of pure tin, on account of its flexibility; the perpendicular part thereof may be made of block tin, or any other metal. The top of this part at *j* is closed. The two parts are connected together at *k*, by a union joint, in order that they may be detached when not in use: *l* is an iron bow or brace, placed across the trough for the purpose of retaining the air-tube firmly in its proper situation. I place the trough under the cock, and fix it so high in its frame that the bottom of the trough may come within an inch of the orifice of the cock. I then fix the air-tube into the brace, *l*, so that the orifice of the tube may be at least one inch above the orifice of the cock; but it ought also to be at least one inch lower than the level of the upper edge of the trough. The perpendicular part of the air-tube ought always to be of such a length that its top may reach (when the tube is fixed as above, ready for acting) higher than the surface of the liquid in the cask. The horizontal part of the air-tube is then bent, so that the cross-piece, *i*, at its end may be, and it then is, driven (air-tight) into a hole, made either through the bung of the cask, or through a hole made for the purpose in the cask, above the surface of the liquid therein.

It is proper to observe, that there must be no passage

for air into the cask, except through the air-tube, by means of the orifice at its lower end.

The apparatus being thus adjusted, I open the cock. The liquid then flows into the trough, until it rises so high as to close the orifice of the air-tube. The consequence of this is, that the further admission of air into the cask is prevented, and the flow of the liquid through the cock ceases. I then put the syphons in action, by drawing the air out of them successively by the mouth, applied to a bent tube, one end of which is placed against the end of the syphon, so as to form an air-tight tube with it. As I thus put each syphon in action, I place the bottles so that the end of each syphon enters the necks, and the point to which I desire to fill them is brought on a level with the orifice of the air-tube, the rail, *g*, being adjusted so as to retain the bottles at this elevation. As the bottles fill, the surface of the liquid in the trough sinks, until it descends below the orifice of the air-tube. The instant this occurs, the air rushes into the cask, and the liquid immediately recommences and continues flowing therefrom, until it gains so much upon the discharge through the syphons, as again to rise in the trough so high, as to close the orifice of the air-tube, and then the liquid ceases to flow from the cask as before. Thus, by this alternate action, it is evident that the surface of the liquid in the trough is always preserved nearly on a level with the orifice of the air-tube. As each bottle fills, it is withdrawn quickly from its syphon, and replaced by an empty one. But if the bottles are suffered to remain, they will never fill higher than about the level of the orifice of the air-tube, which it has been shown is the level to which the liquid in the trough is confined.

Where the liquid to be bottled is malt liquor, or any other of a viscid nature, its frothing in the air-tube would prevent the free admission of the air into the cask. I obviate this by placing in the trough, under the orifice of

the air-tube, a floating vessel, containing more water than sufficient to fill the air-tube up to the level of the liquid in the cask. This vessel (rising and falling with the liquid in the trough) causes the water in it to exclude the air from, and admit it to the cask, in the same manner as if the liquid in the trough were in direct communication with the orifice of the air-tube.

The above is a description of the apparatus constituting my invention, according to the construction which I conceive to be the best; but the apparatus admits of numerous modifications which still retain the principles of, and are, in effect, my said invention. Those modifications are too numerous to admit of a particular description of each; I shall therefore confine myself to the following one alone. It is evident, from the said description, that the chief principle of my said invention is, the limiting the surface of the liquid in the trough, so that it shall not exceed a certain level or point in the trough, and the maintaining it nearly at such level. In the apparatus before described, this is effected by means of the said air tube; but it may be effected with a sufficient degree of exactness for practice, by substituting for the air-tube the following apparatus:— A valve, of similar construction with the throttle valve of a steam-engine, is fixed in the lower end of the nozzle of the cock. To one of the ends of the pivot on which this valve works (and which end projects to the outside of the cock), is attached a short lever, at right angles with the pivot, and to the end of this lever is attached a float. These several parts are so adjusted that, as the liquid rises in the trough, the float also rises, and causes the valve to shut, when the surface of the liquid has attained its proper level, and of course prevents any further flow from the cock; and as the said level sinks by the liquid running from the trough through the syphons, the float also sinks, and causes the valve to open, and of course restores the flow from the cock. The consequence is, that the surface of the liquid in the trough is always preserved at nearly

the same level. It is evident that when the above substitution is practised, the cask must have vent.

Instead of describing any other modification of my said invention, I declare that any apparatus, of whatever construction, whereby the liquid to be bottled runs from the vessel in which it is contained into another vessel, and from thence through a syphon or syphons into the bottles, and whereby the flow of the liquid from the first into the second vessel is regulated by the rising or falling of the surface of the liquid in the second vessel, is to all intents my said invention, and I claim it as such ; and I also declare that the using it for bottling liquids, without my permission, will be an infringement of the said letters patent.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

Letters patent for the apparatus were obtained in the present year for England, Scotland, Ireland, the Colonies, and all other parts of the United Kingdom ; and the preceding description of the invention is the copy of the specification of the Irish Patent, which is selected for publication as being somewhat more correct and perfect than the specification of the Patent for England.

Conviction that the common method of bottling liquors is capable of, and indeed requires, great improvement, cannot fail to impress itself on the mind of every one observing that tedious, fatiguing, and wasteful operation ; and conviction that the before-described invention has attained its object so perfectly as to render any further improvement almost impossible, will, it is not doubted, equally impress itself on the minds of those who consider the nature and effect of the apparatus attentively.

The simplicity of its construction cannot be controverted : That it obtains the most perfect command over the liquor, will be obvious, from the following enumeration of its advantages.

This enumeration, though too self-evident to be necessary to those who shall have perused the specification with much attention, yet will probably be not unacceptable to others.

As many bottles as will fully employ one workman in changing (and four are found sufficient for this purpose), can be kept filling at the same time. The bottles can be filled to any point required, and the moment they are so filled, the liquor (without the least intervention of the workman) ceases running into them. This advantage affords great facility and relief to the workman. The rapidity with which he can *bottle* equals that with which he can change the bottles; yet he is not precluded from bottling even more slowly than by the common method, or in any intermediate degree. He has not to undergo the fatigue of holding the bottles while filling, nor is a continual watchfulness over them requisite; on the contrary, he may at any moment leave the apparatus in full operation, and it will continue so until the bottles are all filled to the point required, when it will immediately (and of itself) cease to act.

Should a bottle be required to be partly emptied, it is effected by merely elevating it immediately before withdrawing it from its syphon; or should it be required to be filled fuller than the others, withdraw it more slowly from its syphon, and it is done.

The exactness with which the bottles can be filled to any required point, not only prevents any overflow of the liquor, but allows the workman to cork them without even looking where the surface of the liquor in them is. The consequent saving of liquor and of time is considerable.

The very trifling difference of level between the surface of liquor in the upper trough, and the point of discharge of the syphons, renders the stream into the bottles so gentle as not to cause the least frothing, (hardly a bead). This is obviously a great advantage, particularly in bottling malt liquors.

Six dozen of quart bottles have been filled in the space of about ten minutes.

The above fact, coupled with the before-enumerated advantages, indisputably proves the utility of the invention, and the great economy attendant on its use.

The apparatus is of a portable size, and of a very lasting construction.

In our next Number we intend to insert the specification of Mr. John Masterman's invention of a machine "for corking bottles," which is considered capable of being combined in use very advantageously with the above-described bottling apparatus.

Account of various Plans for the construction of a Tunnel under the Thames.

Abstracted from the Papers and Documents of the "Thames Archway Company."

WITH PLATES.

An Act of Parliament having been recently obtained for the incorporation of a company for making a tunnel beneath the bed of the Thames, at Rotherhithe, through which persons, horses, and carriages may pass from the opposite sides of the river; and a sum of nearly 200,000*l.* having been subscribed for defraying the expences of this undertaking, according to the plan for which Mr. Brunel, so well known for his numerous, ingenious, and highly useful inventions, obtained a patent, January 20, 1818, to whom the execution of this work is intrusted; and the public attention having been strongly excited by the actual commencement of this important concern on the 2d of March last, when the first stone of it was laid by Mr. Wm. Smith, MP. for Norwich; we have thought that an account of some of the most ingenious of the plans which were prepared for the construction of a tunnel, in 1809, at the suggestion of a former company, who first attempted this project at nearly the same spot, would be acceptable to our readers, and shall

accordingly introduce one of these plans in our present Number, and give the others as speedily as circumstances will permit, concluding the subject with the specification of Mr. Brunel's patent, or an ample detail of his plan, as may be deemed most interesting, with an account of the mode in which the work shall be executed.

The plan which we shall first notice, and several others, were transmitted to the "Thames Archway Company," in consequence of an advertisement inserted, by their order, in the newspapers in February, 1809, offering a premium of 200*l.* for the plan for the construction of a tunnel beneath the Thames, from Redriffe to Limehouse, of which they should most approve; and a further sum of 300*l.* when such plan should be successfully executed. An account of this transaction, and of the history of the tunnel up to that period, may be seen in the 14th vol. of the second series of the Repertory of Arts, p. 397.

The plans sent to this company in consequence of this advertisement, amounted to no less than 54, and were by them submitted to the examination of Dr. Hutton and Mr. Wm. Jessop, who made their report on them the 3d of July in the same year, and recommended that the authors of six of them, which they selected, should be invited to revise their plans, and send farther explanations and descriptions of the same, with which request they complied; and the new or enlarged plans were again submitted to the consideration of the same gentlemen, who, in the August following, selected two out of the six, one of which they recommended "for its enlarged capacity and saving of expence," and the other for being least liable to hazard in the execution; and deferred deciding between them till the authors should reconsider and mature their designs.

The two plans having been sent to their authors for this purpose, and being again returned after due revision and reconsideration, were again sent to Dr. Hutton and Mr. Jessop, who decided in favour of the one, an account of an experiment on the principle of which was published in the second series of the Repertory of Arts, Vol. XXIV.

p. 18, and which was the joint production of Mr. Charles Wyatt and Mr. Hawkins.

Several of the plans rejected had, however, great merit, and some of them would, we have little doubt, be thought by many at least as excellent as that which the judges preferred; though certainly, considering the great experience and knowledge of these gentlemen, and the very great attention which they paid to the subject, their decision must be esteemed of the greatest importance.

But on this point our readers will of course judge for themselves, when they have examined the plans which we shall present to them, and of which the following was one.

Plan for making a Tunnel beneath the river Thames. Signed 1·4142. Addressed to the "Thames Archway Company."

Gentlemen,—In troubling you with the sketches accompanying this, my hopes are not very sanguine that I shall be entitled to the reward you have offered. Your papers came to my hands at a very late period this month, and at a time when my other avocations would permit me to devote but a very few hours to the subject.

From your printed description I conclude it would be impossible to make an under-ground tunnel, without making it completely under the rock. You would then run the hazard of cutting into the spring you bored into in the bottom of your shaft, with all the difficulties of cutting through the quicksand on the northern side of the river, besides the necessity of either lengthening your ascent and descent very considerably, or making them much steeper. I should therefore prefer cutting it through the river.

The way I propose is, by cutting open the bottom of the river, about 50 feet at a time, first inclosing the space with piles as high, or a little higher, than low water mark; on the top of which should be fastened a cassoon, whose top should reach two feet above high water mark, and which might be floated on and off with the tide, as found necessary.

The bottom of the cassoon is described in fig. 3, (plate VII.) It is there shown with part of the timbers naked,

and part covered with a floor. The outside measure is 48 feet by 23 feet 6 inches; in the middle of which is an aperture of 34 feet by 9 feet 6 inches. This opening is intended as a way into the works below, for hauling up the earth, and letting down the necessary materials. This bottom is to be covered with thick planks, except the aperture. Round the aperture is to be raised a strong frame work, well braced, sufficiently high to reach two feet above high water when the cassoon is fixed in its place, with a lining of planks, K, round the outside of this frame-work. Round the outside of the bottom are also to be raised planks, L, with proper knees, &c. similar to the sides of a barge, to the height of four feet; the whole of the planks to be caulked.

The cassoon thus formed will float in the water, and will also be able to carry a considerable weight. It may be said to resemble a great square box, with a hole in the bottom, and a rim round the hole to keep out the water.

My cassoon being made, and afloat, my first step would be to drive 30 piles in the bed of the river, in the direction of the tunnel, in 10 groups (see fig. 6), sufficiently distant to receive the cassoon between them. On the tops of those piles I would lay five cross beams, three of which are shown on the piles, and the other two are omitted, to show more plainly the position of the pile heads.

Those beams and the pile heads should be firmly bolted together, after which the cassoon may be floated on them, placed in its proper position, moored firm, and suffered to rest on those beams with the fall of the tide. It should then be fastened down to the piles, and the water let into it through a scuttle made for that purpose, to prevent its efforts to rise with the following tide. The pile engine may then be placed on the cassoon, and piles driven all round it close to the former ones. They should be driven, if possible, down to the rock; or, if the clay is too hard to drive through, it must be bored to receive them, using an iron cylinder, or section of one, in boring through the gravel, to prevent its running into the hole.

When the piles are all driven, they should be bolted to the bottom of the cassoon; then frustrums of triangular prisms, made of wood, should be driven into the interstices, between the pile heads and the cassoon, and the whole caulked as far as the water will permit.

I prefer driving double rows of piles, corner to corner, as shown in the plans, instead of single piles, side by side, for the following reasons:—

1st, It is the strongest way of the timber.

2d, It affords a better chance of driving them nearly water-tight; but it being impossible to drive them perfectly close, or accurate, by driving the row next the cassoon first, and afterwards driving the outer row, with its angle in the interstices of the others, with the bottom end of the pile shaped and shod, so as to draw towards the interstice, in driving there is a greater chance of making the whole tight. In the outer row of piles I would champher off a part of the two sides that came in contact with the inner row, as shown in the piles, A B, fig. 5, so as to leave a wedge-like opening, as at C D and E, next the water, for the purpose of filling it with oakum, thin wedge like slips of wood, or other matter, that might be necessary to fill any of the joints where the water may be found to pass through, and which the water itself would force into the interstices.

My piles being drove, and made as tight as possible, both among themselves and to the cassoon, the next thing is to pump out the water, and place the interior framing, G H, fig. 1, to resist the pressure of water against the piles; then sink down to E F, fix that framing for the same purpose; then down in like manner to C D, which would be the last framing.

Then excavate for the bottom of the tunnel, and build it.

The cross beams extending from C to D might be taken out one by one, and the holes filled up with brick-work, when the tunnel is banked up sufficiently high to secure the feet of the piles at bottom, placing other shores across the tunnel to prevent its pressing together before it is loaded.

The tunnel I propose a complete circle of 13 feet diameter inside, with a carriage way of 7 feet 9 inches between the curbs, a footway on one side, and lamps the other. The thickness of the wall to be three bricks; but as this would be buoyant if the water got under it even with two feet of clay on it, and it ought to be placed sufficiently deep that it should not be injured with anchors cast in the river, I would place the top of the tunnel at least six feet below the deepest part of the river, and cover the whole of it either with a good puddle, or well-tempered and rammed clay.

I conceive in working the tunnel from one way only, it will be necessary after the first length is turned, to have a second cassoon and second sets of piles, placed next the first, and both empty of water at the same time; for in order to join the second length of tunnel to the first, it will be necessary either to cut away the ends of the end piles from between the two lengths, sufficient for the arch of the tunnel to be brought under them, or the end piles must be drawn and replaced again, with the lower ends close to the tunnel after the two lengths are united.

The second length of tunnel being finished, a third cassoon and third set of piles will become necessary, for the first must not be removed until the tunnel is continued from the first length in the contrary direction. The way I would therefore work should be thus:—

My first cassoon, and consequently first length of tunnel, should be placed with its middle nearly over the letter *h*, in your engraved section, (See Repertory of Arts, second series, Vol. XIV. p. 397) where I would avail myself of your present driftway, by sinking through the rock and driving into it, for the purpose of draining the work as I went on.

My second cassoon, and second length of tunnel, should be towards the Surrey shore; my third would follow it in the same direction. I would then shift my second, letting the first remain, and so on alternately with the second and third, until I got landed on the Surrey side.

I would then return again to the first, and work across the river in the contrary direction, by alternate shifting as before, taking away my first cassoon, which, after one length was worked from it in the northward direction, would become useless.

I do not conceive that any of the piles by the sides of the tunnel could be drawn after they are once used; the only thing that can be done in that case will be to cut them off even with the ground.

Two or three ports might be made in the sides which inclose the aperture in the middle of the cassoon, one above the other, through which the earth taken out, or bricks, &c. to be taken in, might be passed, instead of drawing the whole up to the top, when the tide was low, using the lowest when the tide was out, and shutting that and using a higher one as the tide rose.

If the piles here shown should, on trial, be found insufficient to keep out the water, the only way then left would be, to drive another row of piles, at a distance from those already supposed to be drove; clear the bottom of gravel between them, and form a coffer-dam between those last piles and the former ones.

It will be observed I have only contemplated a single tunnel; but two of this kind will be necessary, one for carriages, &c. passing northward, and another for those passing southward, and it would be much the cheapest to make both at the same time.

May 31, 1809. 1·4142.

References to Plate VII.

Fig. 1, A B, line of lowermost timbers of cassoons; C D, E F, G H, interior framings; I I, upright framing round aperture; K K, braces to ditto; L L, outerside of cassoon; M M, piles; N, footway; O O, stones worked in the tunnel to support the footway and curb; P, bottom of the road; Q, high water line; R, low water line; S, bottom of river; T, gravel; U, earth inclining to clay; V, loam; W, earth inclining to clay with shells; X, rock. Fig. 2. Longi-

tudinal section of the tunnel, pile work, and casson. A, bottom beam of casson; B B, ends of timbers of the lower framing, appearing through the tunnel; C C, piles behind the tunnel; D, piles for one length of tunnel; E, part of piles for another length of tunnel; F, high water line; G, low water line; H, ground line; I, top of tunnel; K, bottom of ditto. Fig. 3. Plan of the bottom of cassoon, (A B in fig, 1,) I I, piles; K, lining of planks round the upper frame-work; L, ditto round the outside of the bottom; M M, apertures; N, plan of part of piles for the second length shown under the cassoon. Fig. 4. Plan of the tunnel and frame-work, (C D in fig. 1.) I, part of the piles. Fig. 5. A B F G H, piles, showing their position at one of the beams supporting the casson; C D E, wedge-like openings; I, beam under casson, resting on the piles. Fig. 6. Plan of piles and beams, preparatory to fixing the cassoon.

Report of the Select Committee of the House of Commons, appointed to inquire into the state of the law and its consequences respecting the Exportation of Tools and Machinery.

Ordered to be printed June 30, 1825.

It is necessary, for the purpose of reporting fully to the House on this subject, to advert to the proceedings of the Committee, appointed in the last Session "to inquire into "the state of the law in the United Kingdom, and its con-"sequences, respecting artizans leaving the kingdom and "residing abroad; also into the state of the law and its "consequences respecting the exportation of tools and "machinery; and into the state of the law and its effects, "so far as relates to the combination of workmen and "others to raise wages, or to regulate their wages and "hours of working, and to report their opinion and obser-"vations thereon." From the minutes of evidence taken

before that Committee, it appears that a considerable number of persons were examined respecting the exportation of tools and machinery, and the laws relating thereto, and that considerable apprehensions of evil from the repeal of the laws which forbid the exportation of tools and machinery were entertained by many persons engaged in the manufacture of cotton goods, lace, &c. and also by some manufacturers of machinery, whilst other manufacturers of machinery, persons of great experience and intelligence, were decidedly of opinion that the prohibition to export tools and machines was beneficial to no one, and highly injurious to the commerce and manufactures of this and other countries. The Committee, therefore, in order that a more correct judgment might be formed on matters of so much importance, refrained from proposing any measure to the House at that time, but came to the following resolution:

"That your Committee have examined evidence re-"specting the export of machinery, which will be found "in the appendix; but they are of opinion, that further "inquiry and a more complete investigation should take "place, before this important subject can be satisfactorily "decided on; and they therefore recommend, that the "consideration of this important question should be re-"sumed in the next Session of Parliament."

With respect to the laws which forbid the exportation of tools and machinery, and their general inefficiency to accomplish the ends for which they were enacted, very conclusive evidence was given by Mr. Dean, the Chairman of the Board of Customs, by several of the principal officers of the Customs, and others.

It appears that in consequence of some tools and machines being legally exportable, and others being altogether prohibited, and from the circumstance of new tools and machines being daily invented, and not prohibited by name in any Act of Parliament, it is extremely difficult, and frequently impossible, for the officers of the Customs

to decide upon what is and what is not prohibited to be exported. Every one of the officers examined by the Committee proved the inadequacy of the laws for the purposes intended, and expressed their doubts as to the possibility of any law being rendered efficient, while any tool or machine whatsoever was permitted to be exported. It was also proved by several witnesses, that considerable quantities of prohibited machinery was exported; and the minutes of evidence accompanying this report exhibit a system of smuggling carried on to a considerable extent. This system is safely carried on by the insurance of the machinery which is prohibited by law to be exported; and there is reason to believe that, in regard to the exportation of such prohibited machinery to France, the premium paid to the insurer does not much exceed the duty charged on the importation of such machinery into that country.

Your Committee cannot better express themselves on these subjects than by extracting a part of the evidence taken, (viz. Mr. Galloway's):

"Could you at the present moment, if you wished to "export cotton or other machinery, do so by paying the "insurance?—Yes, any quantity; the greater the better.

"Then are you of opinion that the laws are not effectual "to prevent those articles that are prohibited, from being "exported?—They are wholly inefficient, both as regards "direct and indirect exportation; the direct mode of "sending out machinery in quantities I have stated; the "indirect mode is accomplished by mixing the prohibited "with the unprohibited articles: it is worth any man's "while to order a quantity of *unprohibited* machinery to "get out a quantity of *prohibited*, for under this mode it "is very difficult to separate *prohibited* from *unprohibited* "machinery, and this never can be detected by Custom-"house officers.

"Then while the exportation of machinery and tools to "any extent is allowed, it is impossible to prevent the "exportation of prohibited machinery?—You never can

"prohibit every kind of machinery from going, while you "permit any to go; it must either be wholly open or "wholly closed; there can be no middle course.

"What is the highest rate of insurance for the safe "transit of goods illegally exported, the highest that has "come to your knowledge?—I think it is from forty-five "to thirty per cent. the large premium for small quantities; "if I had 20,000*l.* worth to send, I should pay thirty per "cent. to any port in France; but for 1000*l.* or 1500*l.* "perhaps forty per cent. would be required; the reason "is, that a vessel engaged in such commerce is subject to "all the inconveniences in taking 1000*l.* worth that it "would for 20,000*l.* and the profit on small quantities of "machinery is not equivalent to the increased price of "insurance.

"Do you know how persons export prohibited machi-"nery?—I know of no other means but those I have ex-"plained. A circumstance, that is perhaps a little curious, "came to my knowledge, that the officers, two or three "years ago, actually seized a quantity of machinery going "to France, and some of that machinery was sold at the "Custom-house, and bought, and sent there to the person "afterwards in France, who originally ordered it, and that "transaction, I understand, took place last year; and I "believe the Government and the Custom-house employed "all due diligence, but the plans of the shippers were so "complete, that all the precaution and diligence of the "Custom-house went for nothing."

Evidence was given before the Committee of 1824, and also before this Committee, that a considerable portion of prohibited machinery consists of such ordinary and common parts and pieces of machines, applicable as well to machines which are not by law prohibited, as to those which are prohibited, so that it is difficult, if not nearly impossible, for any one to say that they are actually parts of a prohibited machine. Other machines or parts of machines may be disguised; many parts of prohibited machines are

so small that they may be easily concealed, while other parts, by being packed with tools that can be exported, and also by exporting them from different ports, may be so disposed of as to render detection impossible.

"There are vast numbers of packages," says Mr. St. John, Controlling Searcher of the Customs in London, "which we open, where there are parts of machinery "packed with other iron and steel articles from Birming- "ham, purposely packed for deception; and it is almost "an impossibility for an officer to know whether they are "or are not prohibited, being only parts of machinery." To the same effect it is stated by Mr. Boyd, General Surveyor of the Customs: "Out of a vast number of packages "exported, but a small proportion can be opened at all; "and in opening a proportion of those packages occa- "sionally, they do discover something that is machinery; "but it is always in detached pieces and in parts; large "machines cannot all be made up in one package, and "they have a great deal of difficulty in telling whether "those proportions belong to a machine that is prohibited, "and a great many pass in packages which are not opened "because they cannot be opened. It is a very rare oc- "currence indeed to meet with prohibited machinery "which *appears* so."

It is however asserted, by Mr. Ewart and Mr. Kennedy, that if the searchers at the Custom-houses were well instructed, that they might distinguish the prohibited from the unprohibited machinery, admitting at the same time, however, that it would be difficult to put the law rigidly into effect.

Considerable discrepancies in the laws were also pointed out by the officers of the Customs and other witnesses: thus, presses of all sorts in metal, with or without the screw, is a prohibited tool, but the screw alone is not a prohibited tool; and hence it follows, that nothing belonging to a press is prohibited, except the frame, which is the least important part, and that too, when sent in pieces, which it may be, is not considered a frame. In

other cases tools and machines are prohibited, but the tools to make them are not generally prohibited. Lathes, with the exception of potters' lathes, are not prohibited, be their power ever so great. Steam engines are not prohibited, and yet by means of steam engines and lathes, with other common tools allowed to be exported, almost every other tool and machine may be manufactured.

It was stated to the Committee, that newly invented machines in the iron or steel manufacture, might generally be exported; but that those in the cotton, woollen, linen, or silk, if known, would be prohibited; and all the gentlemen from the Custom-house affirmed that the law was so defective, that, by a little contrivance, the facility of evading it was such, that "all the block machinery at Portsmouth "might be exported."

Much more might be stated from the evidence on this subject; but enough, it is hoped, has been brought forward to show the inefficiency of the laws intended to prevent the exportation of machinery and tools; and it must be evident to every one, that laws that cannot be executed, and thereby become an incentive to fraud, ought either to be amended so as to render them efficient, or totally repealed.

Another important part of the inquiry relates to the policy, in a political and commercial view, of prohibiting the exportation of tools and machinery, upon the supposition that the laws could be rendered efficient to that end. And here your Committee beg leave to observe, that at the times when the several laws were made which prohibit the exportation of tools and machinery, very erroneous notions were generally entertained in regard to commerce and manufactures. It was then a received opinion, that the liberty of exporting any thing that was likely to increase the commerce and manufactures of another country, would be injurious to those of the country from which the exportation was made; and hence arose those various enactments respecting trade, as well as those which prohibit the exportation of tools and machinery from the United Kingdom.

Fig. 1.

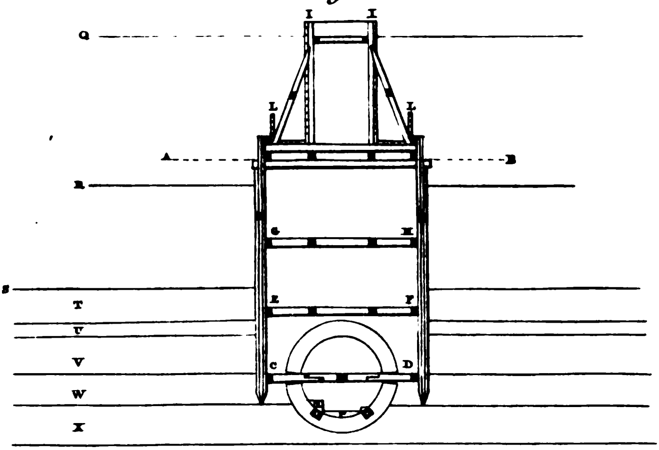


Fig. 2.

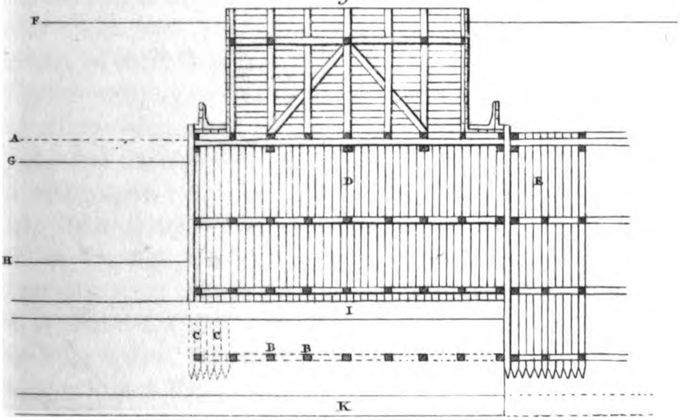


Fig. 3.

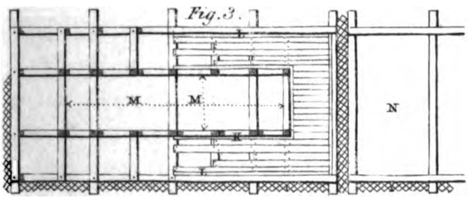


Fig. 5.

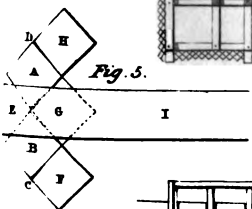


Fig. 4.

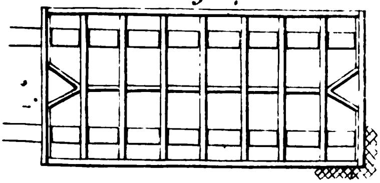
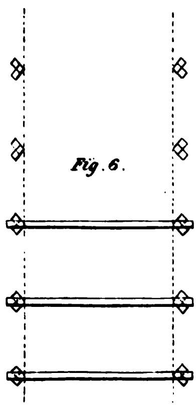


Fig. 6.



The history of the acts which still remain on the statute book relating to the exportation of tools and machinery, would, if unfolded, show both from the intervals of time which elapsed between the passing of these acts, and the perplexity which prevails in the enactments themselves as to what may or may not be exported, that no fixed principle was kept in view, but that they were dictated by a mistaken jealousy of permitting other nations to benefit by our improvements. In order, however, to draw the attention of the House more particularly to the present state of the law respecting the exportation of tools and machinery, your Committee have deemed it proper to put, in an Appendix to their Report, the various clauses of the existing statutes relating to this subject; the slightest attention to which, in the opinion of your Committee, will be sufficient to confirm the observations which they have thought proper to make upon them, and the recommendation with which they have closed their Report.

The first act pointed out by the Commissioners of the Customs, as a rule for their conduct, is the 7th and 8th of William 3, (1696,) when the exportation of the new stocking frames (invented by William Lee, AM. of Cambridge, about the year 1600) was first prohibited, being about 100 years after their invention, and nearly 30 after their introduction into France; and it will be seen by sect. 9, that even the removal of these frames from place to place in England, was prohibited in all cases, unless due notice was given to the company of frame-work knitters in London. It is still illegal to remove any of these stocking frames from one town or place to another, although it would be altogether impossible to give the notice required, or to obtain such leave, as the frame-work knitters company has ceased to exist for upwards of half a century.

To be continued in our next Number.

Description of a Udometer, a new instrument, which shows the quantity of rain fallen. By M. NICOD, *of Vevay.*

(From the Bibliothéque Universelle.)

THIS instrument is composed of a circular basin, made of tin-plate or copper, the outer edge of which is surrounded by a double inclosure, forming a canal. An opening is made six lines above the bottom, so that the basin cannot become full of water, but all the rain that falls into it runs out, through this opening, into a receiver placed beneath. Through the whole height of this vessel there is a vertical slit, covered by a strip of glass, which closes it hermetically, and allows the height of the surface of the water in the vessel, and all its variations, to be seen. A scale, divided into inches and parts, is marked at one side: and a tube, closed by a cork, serves for emptying the vessel when it is full of water.

The basin communicates, by a closed canal above, with another and a smaller basin, surmounted by a cylindrical reservoir, which has likewise a longitudinal opening, closed by a piece of glass, in the same manner as in the larger basin. At the side a scale is marked, which is lengthened in the ratio of the difference of the diameters of this reservoir and of the large basin. This reservoir, which is filled with water before it is put in place, being constructed like the reservoirs which supply oil to the wick of an Argand lamp, replaces the water which evaporates from the large basin, by means of the canal of communication.

The effect of this instrument is as follows:—when it rains, all the water that falls into the large basin passes into the receiver below, where the quantity of it may be afterwards measured. When the rain is over, and evaporation begins to take place, the water which evaporates from the large basin is immediately replaced by the water contained in the little reservoir, and the scale on the latter shows at once the quantity.

Account of a large refracting Telescope, constructed by M. Fraunhofer, in 1824.

(From Schumarcher's Astron. Nachricten, Nos. 74 and 75.)

This instrument, which is one of the largest of its kind, is intended for the Imperial Observatory at Dorpat. Its object glass has 108 Paris lines in diameter, (9·592 English in.) and 160 inches focus, (169·75 English in.)

A great impediment to the observation of celestial objects by large telescopes, is the apparent diurnal motion of the stars, which increases in proportion to the magnifying powers of the instrument; so that stars lying near the equator remain but a short time within its field of view, and traverse it very rapidly. However small may be the motion given to the instrument by screws, for the purpose of following them, it will receive oscillations, which will be larger as its powers are greater. Before the instrument has come to rest, the star will have crossed the field of view, so that the observer will see it perhaps only for a few moments, and as it were by accident, under favourable circumstances; which circumstances will be more rare, as a star is only seen to advantage in the centre of the field. These difficulties could only be removed by making the telescope follow the stars by machinery, whether their motion was apparently slow, as at the pole, or rapid, as at the equator.

To obviate these difficulties, this telescope has been mounted in a peculiar manner; one of the two principal axes on which it is made to turn, is so inclined towards the horizon, that its inclination may exactly correspond with the latitude of the place, and is consequently directed towards the pole. The second axis, called the axis of declination, is exactly vertical to the first or hour axis. Thus, by directing the instrument towards a star, the hour axis need only be moved with that velocity which will make it turn round once in 24 hours, like the axis of the earth; by which means the star will always remain in the

field of view, as long as it remains above the horizon. This motion is imparted to that axis by means of clock-work, consisting of two distinct parts. The power of the one part (moved by a weight), overcomes the resistance and friction of the mass of all attached to the telescope, which amounts to several hundred weight; the other part regulates the motion. But in order to prevent concussion in the motion, and make it uniform, the clock-work, instead of being regulated by the usual vibrating pendulum, is governed by a centrifugal pendulum, which, inclosed in a hollow cone, turns always in one direction, and both the parts of the work may be wound up, without the motion of the telescope being interrupted in any degree whatsoever. The telescope may also be stopped, and again set in motion, without arresting the movement of the clock-work; and if required, it may also be moved in any direction, either by the hand, or by means of a screw. The motion of the clock may at any time be accelerated or retarded, by simply moving a spiral disk to a different degree of its division. By this means a star may be moved to the centre of the field of view, which is peculiarly useful in micrometrical observations, and is not practicable in any other manner. By means of this disk we may give the telescope instantly the movement corresponding with that of the moon, or any of the planets.

In order to render an uniform motion of the telescope possible, it must be completely balanced with respect to its two principal axes, in whatever position it may be brought, without, however, this balancing occasioning any impediment to its being directed towards any point of the sky that may be required. With respect to the axis of declination, the telescope not being fixed on its centre, is balanced by two weights, placed near the eye-glass, and fastened to two conical brass tubes, each having in the point of gravity an axis, intersecting that of the other at right angles; so that in this respect the telescope is balanced in every direction. With respect to the hour

axis, the telescope is balanced by two weights, one of which is fixed immediately on the axis of declination. The second weight is fastened to a bar of a peculiar shape, forming a ring towards the hour axis. This ring touches (by means of two other axes placed opposite each other) a second and smaller ring, which ring turns on the case that contains the axis of declination; so that also with respect to the hour axis, the telescope is balanced exactly in every direction. In order to prevent the friction of the hour axis, and its pressing on its bed, another weight is added, operating on the bed of two friction rollers. By all these arrangements, the telescope, notwithstanding its size, may be moved by one finger.

The pedestal is of such a shape, that although its position must never be altered, it cannot hinder the telescope from being turned towards any point of the heavens. It might seem that there were situations of the telescope in which the pedestal may be an obstacle against following the star; yet the instrument is so constructed, that the telescope may be directed in two ways on the same object, simply by turning the hour axis 180°. Thus, if the pedestal be an obstacle on one side, the turning this axis will render the telescope free on the other side.

As it is very difficult with a large telescope to find an object, and bring it within the focus, it is usual to add to it a small one, the axis of which is perfectly parallel with that of the large one. The finder of this large refractor has 29 lines diameter (2·57 English in.), and 30 inches focus, (31·97 English in.)

Each of the two principal axes has a graduated circle, called the hour and declination circles. These are fastened to the axes, and turn with them. The division of the hour circle shows four seconds of time, and that of the declination circle, 10 seconds of space. By this means those stars which are out of the meridian may also be found and observed in the daytime, which cannot be observed so well in many particulars at night.

In the line-micrometer belonging to this instrument, both threads may be separately moved by a screw ; partly for the purpose of placing each thread where it may be required, and partly for enabling the observer to make a kind of repetition in the observations with micrometers, which, with the use of the clock work that moves the telescope, is much more practicable than in the common way of mounting. In the same way the eye-glass is separately moveable, in order to make the two threads stand always equidistant from the centre of the field of view, which makes them both equally distinct. That part of the micrometer containing the threads, supports, besides the necessary correction screws, &c. two graduated verniers, in opposite positions, moving upon a graduated circle, made for measuring the angles of position. The verniers read off to one minute. The micrometer may be gently moved, with respect to the position circle, with the hand or by a screw. The lines only are capable of being illuminated, leaving the rest of the field of view quite dark. As the position circle must remain unalterable with respect to the position axis, but the micrometer, together with the apparatus for lighting the threads, must be capable of being turned, M. Fraunhofer was obliged to make a disposition of it different from that which he had before employed with micrometers without a position circle. The whole field may also be lighted. The micrometer has four distinct eye glasses.

The telescope is to receive moreover a lamp-circle micrometer, with four eye glasses ; a lamp net micrometer, with three eye glasses ; and finally, four ring micrometers, two of which contain double rings.

As distinctness can only be properly obtained by the axis of the object glass, and that of the eye glass being exactly in the same line, and a deviation in this respect being more injurious in large object glasses than in small ones, a particular instrument is to be added to the telescope by M. Fraunhofer, by which this deviation may be found and corrected.

M. Fraunhofer states in the beginning of his memoir, the advantages which refracting telescopes have over reflectors, the most perfect of the latter requiring to be of immense size to produce any effect, from their reflecting but a small portion of the light which they receive. The impossibility also of rectifying the deviation of the rays, caused by the spherical form of their reflecting surfaces, have caused refractors to be preferred for mathematico-astronomical observations, and for meridional instruments.

The glass of the refractors, on the other hand, lets all the rays pass, which, with the contrivance of Mr. Dolland for making them achromatic, and other improvements, have caused almost all astronomical observations to be performed by their assistance.

The largest refractors hitherto made, are but small in comparison with the largest reflectors. It is well known that the effect of the telescope lies not in its length, but in the diameter of its object glass; and that in those in which this is double the size, the power will also be double. Mr. F. computes that the difficulty of making large achromatic telescopes, is nearer in the ratio of the cube of the diameter of the object glasses, than in that of their diameters directly. One of the difficulties was, that the glass used for object glasses could not be obtained as perfect as large instruments required. The English flint glass has undular lines, which disperse the light irregularly in its passage through it; these streaks being of course more numerous as the glass is thicker and larger. The English crown glass has also these undular streaks, although not always visible to the naked eye. The Bavarian flint and crown glass is, however, free from these streaks, and equally compact throughout. The difference between these two sorts of glass, in the power of dispersing colours, is also in favour of the Bavarian glasses. Between the English flint and common glass this power is as 3 to 2, while in the Bavarian flint glass it is as 4 to 2, which gives the latter a decided preference.

There were not any fixed theoretic principles for the construction of achromatic object glasses, and opticians were obliged, to a certain degree, to rely on chance, and to polish a greater number in order to select the best; and this chance became less as the glasses were larger. This arose both from the means formerly applied for ascertaining the powers of refraction, and dispersion of colours in the different species of glass, not being sufficiently established; and from the methods hitherto used for grinding and polishing the glasses not being calculated to follow the theory with that degree of exactness which they ought, to avoid palpable indistinctness.

M. Fraunhofer states that all these impediments, and several others, have now been successfully removed, partly by inventions and partly by discoveries, to which he was led in pursuing this object; and gives us reason to expect that he will favour us with an account of them, having declared the probability of his entering more largely on this subject on another opportunity.

A plate of this large refracting telescope may be seen in the second volume of the Memoirs of the London Astronomical Society.

Notice of the existence of Iodine in the Mineral Kingdom, by M. VAUQUELIN.

(From the Annales de Chymie, Vol. XXIX. May, 1825.)

IODINE has not been found hitherto but in certain vegetables, and in some marine moluscas. M. Cantu, professor of chemistry at Turin, has indeed discovered some traces of it in a mineral water of Asti; but no one that I know has as yet found it combined with minerals.

Mr. Joseph Tabary having sent me a few weeks ago some argentiferous minerals, which he had bought from the natives of South America, and in part collected himself

in the vicinity of Mexico, in an extent of 25 leagues radius, to determine the quantity of silver contained in it, and that of the gold, if any of this latter should be found, has furnished me with the fortunate opportunity of making the discovery which I have now the honour to lay before the academy.

One of those minerals, which was labelled "*Virgin Silver of Serpentine*," (and of which the physical properties are—1st, A whitish colour at its surface, where worn by rubbing, and exhibiting grains of metallic silver; 2dly, A laminous fracture, of a greenish yellow, with some black parts and some metallic silver), is that in which I have found iodine.

Twenty grains of this mineral, treated with nitric acid, were attacked with effervescence, and the developement of nitrous gas towards the end. After having boiled it for a considerable time, the liquid diluted with water exhibited two substances; the one, very heavy, was quickly precipitated; the other, being light, remained a long time suspended in the liquor. They were separated from each other by decantation, washed and dried.

The first, which weighed 6 grams and 42 centimes (120·88 grains), was easily fused by the blowpipe, giving out a purple flame, and, at the end of some time, a globule of silver appeared in the midst of the fused matter, which spread itself over the charcoal in the manner of chlorite of lead. The edges of the charcoal were coated with a yellow powder.

The other matter, which was brown, weighed 2 grams, 70 centimes (50·84, or nearly 51 grains). It inflamed by the heat, in giving out an odour of sulphurous acid, and left a residue of sulphuret of lead, mixed with a little iron, which weighed 1 gram 58 centimes (29·65 grains).

The first matter, that which weighed 6·42 grams, being treated by muriatic acid with heat, communicated to it a reddish brown colour, and produced a slight effervescence

with an odour of chlorine. In proportion as the temperature was increased, this effervescence became more lively, and presently it assumed a beautiful violet colour: immediately the vessel was taken from the fire, that the violet substance might not be lost. There remained at the bottom of the acid a yellow matter, containing grey particles, which dissolved in the warm water, with which this matter was washed.

This water acquired a reddish brown colour, and the property of colouring a solution of starch a beautiful blue. After having passed water many times over this matter, we boiled it with alcohol, which became coloured in its turn in a manner much more intense, and which equally acquired the faculty of forming a blue combination with the solution of starch.

Suspecting, but without, however, believing it (so much did the circumstance seem to us extraordinary), that this violet vapour was produced by iodine, we submitted the above muriatic solution to distillation, after having diluted it with a little water. We then with pleasure saw that our suspicions were realized. In effect, the violet vapours which arose, immediately crystallized on the sides of the adopter and of the balloon fitted to the retort, in assuming the needle form and the colour, which are peculiar to iodine; but the acid was not entirely discoloured.

Although the yellow matter had boiled some minutes with the muriatic acid, it was not however entirely decomposed; for having fused 2 grams 28 centimes of it with 2 grams of potash, and having washed the result with water, we obtained an alkaline lee, which, saturated with sulphuric acid, and mixed with starch water, gave a very beautiful blue colour by the addition of a few drops of chlorine. The part which was not dissolved in the water, was a powder of metallic silver, weighing 1 gram 63 centimes (30·60 grains).

Being convinced by the foregoing experiments of the

presence of iodine in the argentiferous mineral, we sought to obtain it by a way more direct, which would permit us to determine the quantity, and to know the mode of combination in which this matter was found.

In consequence, we caused 5 grams (94·15 grains) of it, in powder, to be heated with 2 grams (37·66 grains) of caustic potash, with a little water to facilitate the mixture. The matter being kept red hot some time, we mixed it with water, and after having decanted the latter, we washed the residue until it was no longer alkaline. This residue was a dirty yellow, and weighed 4 grams 46 centimes (83·98 grains). We will return to it presently.

A portion of the alkaline lee being saturated with nitric acid took a yellow tinge, and had the property of making starch blue on adding to it some drops of chlorine. In fine, it was precipitated of a blackish brown by nitrous acid, and of a red by nitrate of mercury.

The 4 grams, 46 centimes, remaining after the action of the potash, being treated with diluted nitric acid, became dissolved with effervescence: but there remained a yellowish substance, which resembled nearly, in the colour, chlorite of silver. Being washed and dried, this matter weighed 80 centigrams (14·86 grains); it became a yellow orange by the heat, and returned to a yellow green by cooling.

We ascertained that this matter was iodite of silver, which proved that the alkali had not effected the complete decomposition of this substance, although it was in excess. The quantity of silver dissolved by the nitric acid was 41 centigrams and a half (7·81 grains).

The potash having thus taken up 50 centigrams from the 5 grams of the mineral, which could be nothing else but iodine, and as we had obtained besides 80 centigrams of the iodite of silver, in which there is contained, according to the modern chemists, $42\frac{1}{2}$ of iodine, it follows from this that these grams of the mineral contain 92·50 of iodine,

which, being divided by 5, gives 18·50 for the 100 of the mineral.

There remained no more doubt with us of the existence of iodine in this silver ore. However, we wished to know if we could obtain the hydriodite of potash crystallized. For this purpose we saturated with sulphuric acid the excess of alkali contained in the lee, of which we have spoken above; and after having evaporated it to dryness, we treated it with alcohol of 30°, to separate the sulphate of potash. We then evaporated the alcohol; and the mother water, abandoned to spontaneous evaporation, furnished crystals in square prisms, which had all the properties of common hydriodite of potash.

From henceforth then iodine may be considered as one of the elements of minerals; and this will be a motive for chemists not to neglect the search for it when they analyze metalliferous minerals, particularly when they contain silver; for, as well as chlorine, iodine has a great action on this metal.

To which of the substances contained in the silver ore iodine was united, is now to be determined. It may be recollected that we found in it sulphur, silver, lead, and carbonate of lime, which served as the gangue. We may at once exclude the carbonate of lime. The difficulty of decision exists only between the sulphur, the lead, and the silver. It is not at all likely that this matter should be united to the sulphur; this latter, as well as the lead, being laid naked by the nitric acid, even when diluted, on the silver ore. There is more probability that the sulphur is united to the lead, and to a part of the silver. On the other side, if we consider that, in proportion as the nitric acid dissolves the metallic silver, and decomposes a part of the sulphuret of lead, it throws down the iodite of silver, on which nitric acid has no action, we shall be disposed to believe that the iodine is combined with the silver. Besides, what seems entirely to confirm this opinion is, that

we can take from the silver ore a certain portion of iodite, by boiling it for some time with ammonia. Finally, it is well known that iodine, as well as chlorine, has a great affinity for silver.

I will deposit in the cabinet of the King's garden what I have remaining of this mineral, to serve as a point of comparison, in case the locality of this mineral should hereafter come to be discovered.

Extract of a Report made to the French Academy, by M. Ampere, *on the dry (galvanic) columns of M. Zamboni.*

(From the Annales de Chimie, Vol. xxix. June, 1825.)

An account has been published of experiments made with dry galvanic columns in 1810, by Mr. Forster, of Essex, which had been previously invented by M. de Luc. The application which has been made to chemistry of galvanic apparatus of a more expensive composition, and the several curious facts which have been discovered by its means, give the circumstances mentioned in the following memoir a considerable interest, especially when we recollect that dry galvanic columns, besides being much cheaper in the first instance, require no expence for acids of any kind, which for the larger combinations of galvanic troughs often come to a serious amount, and also that they demand no cost for repairs or renewal of their parts, being as perfect at the end of several years as at the first experiment.

The original memoir, besides the description of some apparatus which the dry galvanic columns kept continually in motion, contains also an account of the several following facts.

The diminution of the energy of the dry columns ceased at the expiration of two years. M. Zamboni asserts that he has ascertained this by the experience of twelve years.

This diminution, in the two first years, varies according to the manner in which the columns have been constructed.

The dry column is more energetic in summer than in winter, as well with regard to the intensity produced, as to the promptitude with which it becomes manifest.

The tinned paper, called *silvered paper*, exhibits with the black oxide of manganese an electric force, very superior to that which is obtained when the paper is covered with thin leaves of copper; which last sort of paper is known by the name of *gilt paper*.

A pile formed of disks of paper, tinned only at one side, without any other substance interposed, produces electric effects, which can only proceed from the leaf of metal *glued* to the paper, touching it more intimately than it is touched by the paper of the next leaf which is placed beneath it.

M. Zamboni has examined in the columns which he calls *binary*, if the action of the plates is the same as in those composed of leaves of tin, covered with oxide of manganese, or the contrary, and he has acertained that either of those results may be obtained at pleasure, by causing the paper which is glued to the tin leaf to imbibe different substances. If oil is used, the action is the reverse of that produced by the oxide of magnanese; but if on the contrary, honey, any alkali, a solution of sulphate of zinc, or milk half curdled, be introduced into the paper, the binary pile acts in the same manner as that which is powdered with oxide of manganese.

In making use of a dry column of a thousand pairs of plates, which were only between 5 and 6 centimetres (between $1\frac{4}{8}$ and 2 in.) in diameter, M. Zamboni obtained from the condenser sparks of an inch in length, so that with this column an electric battery may be kept constantly charged to an intensity that may be rendered as great as is desired, by multiplying sufficiently the number of plates.

M. Zamboni thinks that a pile of 50,000 pairs of plates, left of the full diameter which the leaves of tinned paper

commonly have, would afford a constant source of electricity, the intensity of which would equal that of a powerful common electrical machine. He expresses strong wishes that an instrument of this magnitude may be constructed, and mentions many interesting experiments which might be performed by its assistance.

On Blowing Machines and on the Expansion of Air. By WELTER and GAY-LUSSAC.

(From Archives des Decouvertes.)

IT is known that when air or any other elastic fluid is dilated, by enlarging the space in which it is inclosed, cold is produced. Messrs. Welter and Gay-Lussac, who have been engaged in researches concerning the heat disengaged by the gases, when their volume is varied under very different pressures, have already discovered several new facts, one of the most singular of which is the following;

The air which escapes from a vessel by blowing through an aperture under any pressure whatever, does not alter in temperature, although it expands on issuing from the vessel.

Hence it should seem to result, that heat is produced in the blowing of air, and that this heat is so much the more considerable as the difference of pressure producing the blast is greater, so that the heat exactly compensates for the cold produced by expansion. This fact would explain the heat produced when air enters into a vacuum, or into a space occupied by air at a less pressure.

It would likewise explain why the blast of the Shemnitz machine (with a column of water), produces cold and freezes water, while the air of the Chaillot engines, where the pressure is invariable, and equal to 2·6 atmospheres, does not alter the thermometer.

NOTICES OF NEW PATENTS.

Patent granted to Mr. WILLIAM JAMES, *of Westminster, Land Agent and Engineer, for improvements in the construction of rail and tram roads, or ways which are applicable to other useful purposes.* Dated February 28, 1824.

THIS patent relates both to a peculiar form of rail-way, and to new methods of impelling carriages on them.

The new form of rail-way proposed is that of a tube, with a flat top, in which shape the patentee thinks they can sustain a greater load on the carriages than when of that commonly used. The new application of these tubular rail-ways, is intended by the patentee as pipes for the conveyance of water, either to give motion to machinery for domestic use, or for other purposes; and he expects that after having a sufficient supply to move water wheels, for giving motion to the carriages on the rail-way, by intervening machinery, he will have enough to spare for general purposes, to form a source of revenue, and so as even to work mills or manufactories to a large extent.

He also imagines that he will economise still further in the quantity of iron, by making the internal rails of double rail-roads broad enough for two wheels to pass at their opposite sides, by which means he can make three rails supply the place of four. To impel carriages on these rail-ways the patentee proposes two methods, in each of which a set of longitudinal revolving shafts are to be placed in the middle, between the two rail-roads, where they are used, or between the two rails in a single rail-road; and in the first case he designs to lodge these shafts inside the middle tube, arranged as above described.

These shafts (being turned round by the water-wheels before-mentioned, or by other power), by intervening toothed wheels fixed at regular intervals (of from 15 to 30 feet for example), give motion to axles or short shafts,

placed at right angles to them, but so as not to obstruct the carriages; which axles in the first method proposed carry drum wheels, which support endless chains, arranged so that each chain passes over two drums, one of which sustains half of the preceding chain, by which means the chains at one side move all in one direction, while those at the other side pursue an opposite course, and thus afford means for impelling the carriages on the two different lines of rail-roads in opposite directions. It is plain that these drums may be placed so as to act either in a vertical or horizontal position, but that in the latter the chain would be more liable to slip off them, though it seems to be preferred by the patentee.

In the second mode of impelling the carriages, instead of drums, vertical toothed wheels are placed, with their planes parallel to the rails; and by one or more of the carriages a long rack is carried, placed so as to be acted on by two of those vertical wheels at the same time; so that when those wheels are all in motion, they will draw or impel the carriages successively, till the latter are driven entirely to the further extremity of the rail-road. The teeth of these wheels are described as being long, and placed far asunder, so as to resemble arms, while those of the rack, being of course made to correspond, will be like the rungs of a ladder, whose figure the rack will assume altogether, if constructed with double sides.

In a matter capable of being so beneficial to the public as rail-ways, we are glad to be informed of every contrivance of ingenious individuals at all applicable to them; for though many of them may be defective, others will be useful, and even those of the first description may tend to elicit serviceable ideas in others, as well as by their discussion to give more accuracy to opinions on this subject.

Where a longitudinal body is exposed to impulses on *every side*, we believe the tubular form will be the most economical, or that in which the smallest quantity of materials

will afford the greatest strength. But where the impulses or pressure must be all at *one side*, another form will have the advantage, which has already, we believe, been determined by mathematicians. Mr. Wood, the author of a valuable treatise on rail-ways, lately published, says, that on account of the pressure moving over every part of the upper line of the rail between its supports, he would prefer the form of a semi-ellipse for its lower part to that of two semi-parabolas, usually considered the strongest, where the weight acts on the apex, or in the middle of the rail. Indeed it is evident at the first view, that if the same quantity of metal which constitutes a tube of six inches diameter, and half an inch in thickness, were formed into a parallelogram of the same length, and double the thickness, which would then be in depth about nine inches, and an inch in thickness, it would, when set edgewise, support a much greater weight than the tube before it would break, both being supported at their ends solely, as is usual in such experiments; and we may plainly perceive that it would sustain much more, if formed as Mr. Wood proposes, which would increase its extreme depth nearly three inches, without our having recourse to the well-known rule for ascertaining the strength by this addition (of multiplying the thickness by the square of the depth, and dividing the amount by the length), which latter being the same in both cases, would, at a rough estimate, show the strength of this form to be to that of the other as 144 to 81. To enter into minute calculations on this point, however, is neither suitable to our work, nor to the limits of this portion of it.

The plan of conveying water for turning mills for manufacturing purposes, through tubes of the diameter that a quantity of metal would afford, less than that of the common rails of rail-roads, as proposed by the patentee, if a serious one, and not the offspring of hasty unweighed thought, can only proceed from a mistaken notion, very prevalent we find among a certain class of inventors, that

fluids can be forced through a given pipe with an infinite velocity; or, in other words, that they can make the fluid pass through it in any quantity in a limited time; on which idea we have known a worthy and ingenious gentleman take out a patent, some years ago, for an engine excelling a perpetual motion, as it was not only to keep itself going, but a large corn mill into the bargain. However this may be, it is well known that the quantity of fluid possible to be conveyed in a given time must depend on the size of the tube; and this being limited as mentioned, the supply can be by no means adequate to the purpose proposed; and we much doubt whether it could afford power even for impelling the carriages on the road to any considerable extent. In some, very few, situations those pipes might serve for conveying water for domestic purposes, breweries, and tan-yards, for the use of dyers and distillers, and other purposes of this sort; but for the reasons before stated, we cannot recommend the tubular form at all as a beneficial one for rail-ways.

The patentee is also mistaken in supposing that there would be any advantage in forming two rails into one, to sustain the load of two carriages, as proposed in his plan for making three rails serve the purposes of four, in two adjacent rail-roads; as it is evident that the rail in the middle must be made double the strength of two single ones, to support the load of two carriages in passing, and must also be double the breadth, to afford them room to pass, and therefore has no stuff to spare to increase its depth.

Of the plans for moving carriages on rail-ways, one very like the first proposed by the patentee has already been made the subject of a patent by Mr. R. Thompson, of Ayton Cottage. Some others mentioned by Mr. Wood resemble it also; but the plan of the patentee differs from them in having a succession of revolving shafts placed along the whole line for conveying the motion.

We cannot conceive what advantage would arise from

placing these shafts within the tubes, as proposed, unless it might be to find some use for pipes that would otherwise be unoccupied: but passing by this matter, we will terminate our remarks on the specification of this patent by recommending the last method for moving carriages on rail-roads mentioned in it, as worthy of being the subject of experiment. In several instances where we have seen carriages moved on rail-roads by chains from stationary steam engines, so much friction and resistance appeared to be produced, by the chains dragging along the ground, which the rollers or sheaves over which they passed seemed to have little effect in preventing, that we have long thought some other better contrivance for effecting the same purpose was much wanted, and conceive that the plan of the patentee (where vertical wheels, moved by shafts, act on a long rack attached to the carriages,) promises to be so far superior, as it will have much less friction and wear of parts than the common method, and avoid its evident defects above-mentioned.

In one of the inclined planes which Mr. Wood mentions, on which carriages were moved by ropes from a fixed engine, the weight of the rope, that of the large wheel at the top, and that of the 73 sheaves over which it passed in a space of 715 yards, amounted altogether to 11,817 lbs. which would be 15·12 lbs. to the yard, or a little more than 15 lbs. which we should suppose would be a sufficient proportion for the strength of the shafts proposed by the patentee, if properly formed (in which respect the tubular shape that he so much admires might be used to good purpose), so as to produce an apparatus which, with little more weight of parts than that in use, would be free from its most conspicuous defects and chiefest inconveniences.

***Patent granted to Mr.* EDWARD JORDAN, *of Norwich, Engineer, for an improvement in the construction of water closets.* Dated March 27, 1824.**

IN this water closet the seat is made to sink an inch or more on being pressed down, which depressing the short arm of a horizontal lever placed beneath, raises the opposite end of the longer arm, which causes a cock with three ways to turn a sixth part of a revolution, which being fixed in a pipe that leads from an upper reservoir of water into a cylindrical vessel containing air, admits the water into it, and causes the air to be compressed with a force proportioned to the height of the reservoir above it; another pipe branches off from the same cock, through which the water flows from the cylindrical vessel into the basin or pan, with an equal force, caused by the reaction of the compressed air; when the pressure being taken from the seat, admits the long arm of the lever to be depressed by a spring placed above it for that purpose, and the cock thereby to be turned back to its first position, which closes the communication between the reservoir and the cylindrical vessel, and opens that between the latter and the pan, in the cock with three ways.

The patentee states that the apparatus may be worked also by moving a handle, and mentions that when the height of the reservoir is not sufficient to compress the air in the cylindrical vessel, that this latter should be raised five feet above the seat, in order to act by the force of the fall of the water in descending.

The patentee seems perfectly conscious of the total want of novelty in every other part of this water closet, by his laying his claim in the specification particularly "to the introduction of the cock with three ways, in the manner and for the purpose explained."

Patent granted to Théodore Paul, *late of Geneva, but now of Charing Cross, for improvements in the method of generating steam, and in the application of it to various purposes. Communicated to him by a foreigner.* Dated May 13, 1824.

To produce steam of a high temperature the patentee, instead of a common boiler, uses a long metallic pipe, of small diameter, which is coiled round, with its coils a little asunder, so as to inclose a space inside of the form of the section of a cone, or other convenient shape, in which fuel can be placed for giving the pipe the heat required.

Into one end of this pipe water is to be driven by a small forcing pump, which, by passing through the pipe, when duly heated will come out at the other end, converted into highly compressed steam.

This is the general outline of the contrivance. For its particular application, though the patentee does not confine himself to any particular shape for the outline of the receptacle for the fuel, which the coils of his pipe are to produce, he however recommends two, of which he gives drawings. The outside of the first exhibits, by the disposition of its coils, somewhat of an ovoide form, obtruncated at its lower extremity, and contracted above in the place where the smoke is to pass upwards; and at the inside they are bent round so as to produce an elevated bottom, in the shape of a hollow cone, the base of which joins the lower part of the external portion, at a section of the ovoide figure, somewhat above the lowest of its foci.

The other figure in the drawings is in the form, externally, of an obtruncated cone, with the base turned upwards, and inside the coils produce the same elevated conical bottom as in that described, with its broadest part joining the lowest portion of the external part, in a similar manner. This latter shape is intended for the use of locomotive engines, as it will facilitate the introduction of fuel by its wide opening above, where it is to be thrown

m. The other shape is intended for general purposes, and in it the fuel is either to be thrown into the upper part, where the smoke escapes, or the coils are to be arranged so as to leave an opening at the side for that purpose. In both methods the whole is to be surrounded outside by a plate iron case, which, to more perfectly confine the heat, should be double; or, in other words, a second case should be placed outside the first, and the space between the two should be filled with brick dust, coal ashes, or some other bad conductor of heat.

The bottom of the case, and of the coil-formed fuel-holder, rests on a flat metal ring, beneath which is a hollow cone of metal plate, with its base next the flat ring, which conveys the ashes from the fuel into a closed ash pit below.

The coals, or other fuel, are to be burned in the space between the elevated conical bottom and the external coil-formed receptacle, the conical bottom rising two-thirds of the height of the latter, to admit of its disposition in this manner. The air necessary for the fire is recommended to be introduced below into the conical ash tunnel, by the pressure of bellows, in preference to leaving the ash pit open.

The pipe is described as being made of copper, but the patentee states that it may be also made of other metals, particularizing platina, gold, and silver, for this purpose, rather unnecessarily, as their great cost must in general preclude their being thus applied. It should be noted that the external fuel receptacle, and its internal conical bottom, are both formed of one continued pipe, so that the water introduced may pass through the whole successively. The patentee advises its being admitted into the pipe at the top of the outside receptacle, when, from the disposition of the coils, it will descend spirally through them to the lowest part, over the flat annular support, after which it will rise circuitously through the coils of the conical bottom, and pass out at its apex into a pipe, which descends

inside in the hollow part of this bottom, and from thence goes to the steam engine. The coils of the pipe in this conical bottom are placed sufficiently asunder to serve as a grate under and within the fuel, both for the admission of air, and the transmission of the ashes downwards: and the mode described, in which the water is to circulate through the coils of the pipe, is that which the patentee advises as best for gradually increasing its temperature to the highest pitch required.

To produce the steam necessary for an engine of a two-horse power, the patentee states that a pipe 150 feet long should be used; and that to sustain an internal pressure equal to 150 pounds on a square inch, it should, when made of copper, have its internal diameter not greater than three-sixteenths of an inch, while its thickness was one-sixteenth of an inch, (its largest diameter from out to out being thus five-sixteenths in extent). When it is made of another metal, its thickness must be varied accordingly.

The reservoir for the water, which is to be injected into the pipe, is represented as placed above the fire-place in the arrangement for stationary engines. In those which are to be used in carriages it must of course have a position more suitable to their circumstances.

When engines of greater power than that mentioned are to be supplied with steam, a number of pipes, disposed as described, either arranged so as to form several distinct fire-places, or all combined in a single one, may be used; the proportion of which must depend on the quantity of steam required. They may also be heated either by the immediate contact of burning fuel, by reflected, radiated, or combined heat, or by inflamed gases.

The size, shape, and arrangement of the coils of pipes may be also varied, provided they are continued without interruption from the extremity where the water is injected, to that where the steam passes off to the engine. The furnace may also be formed and constructed in several different modes, to produce the same effect; the patentee

also states that the pipes may be luted or coated with fine clay, or other materials of a proper description, to protect them from too rapid corrosion by the elevated temperature which they are to encounter.

We have observed in the account of Mr. Burstal's patent in this Number, that great hopes were entertained of forming light boilers, or steam generators, by the principle used in the tubular ones here described, provided Mr. Perkins's patent improvement was added to them of confining the water in them by a valve, till it was required to be let off to the engine in a highly elastic state, or of steam strongly compressed, as otherwise we are convinced from experiments, which we have seen, that the steam formed at the lower end of the tubes, would blow most of the water out of the rest, and leave them nearly empty to the action of the fire. In the method proposed by the patentee, the valves of the engine would alone stop the tubes; but, long as the tubes are directed to be, we do not think their length alone would prevent water occasionally passing into the engine along with the steam, if the valve above-mentioned was not also used for confining the water in them till the proper moment of delivery.

Several patents have been obtained for tubular boilers. One was granted for this purpose to Mr. Cox Stephens, in 1805 (for which see Repertory of Arts, &c. second series, Vol. VII. p. 173), but of a different form and construction from the above. Mr. Woolf also used tubular boilers in some of his patent steam engines several years ago, but the tubes were of a much larger description than those of Mr. Paul, and arranged very differently. Mr. James Curdy, of New York, also obtained a patent for a species of tubular boiler or steam generator, in June, 1824; but the tube which he used, both in size and other respects, varied essentially from that of the present patent. Indeed, Mr. Paul does not introduce his patent steam-generator as his own invention, or as one entirely new, as he candidly

states it to be the contrivance of M. M. Revon and Moulinie, who in 1813 obtained a *brevet d'invention* of 15 years for it in Paris.

In the present state of the invention, and as it regards the important object we have stated, we can only consider it as an experiment of which we have considerable expectations, and, from wishing it to succeed, have given the foregoing advice relative to its improvement. We also think the arrangement of the coils of pipe is far from being the best that might be used, on account of their depending too much on the lateral communication of heat for their increase of temperature, in which direction Count Rumford, many years since, proved that very little heat could be conveyed in comparison of that given from below upwards, by an equal quantity of combustibles. The using those fine tubes as bars to support fuel, is also injudicious, especially for our coals, which require the application of the poker so much, and are so liable to the species of fusion called "clinking," by either of which these small tubes would soon be destroyed. Instead of this we would recommend that iron pipes, sufficiently strong, should be employed for supporting the fuel, made to communicate with one another, like those in Mr. Chapman's furnace (for which he received a premium from the Society of Arts), described in our 46th vol., and that water should be drawn through those iron tubes from the reservoir by the forcing-pump, before it was injected by it into the coils of the long copper pipe. And these latter would most probably have a better effect, if arranged above the fire-place in the form of a low oblong ovoidal dome, somewhat similar to the upper part of a reverberating furnace; and also if covered above by an arch of materials which slowly transmitted heat, than when disposed as directed by the patentee.

We have to add that water may also be prevented from being forced into the steam engine along with the steam, by using a small forcing pump to inject so minute a portion at each stroke, that the whole of it will be converted into

steam in passing through the long red hot pipe, which method we believe it to be the intention of the patentee to use. But in this way most of the steam will be converted into hydrogen, subject to be exploded by frequent casualties; and the pipes also will be worn out much more rapidly than in the method above proposed.

Patent granted to James Neville, *of High-street, Southwark, Engineer, and to* William Busk, *of Broad-street, Esq. for improvements in propelling ships, boats, or other vessels, or floating bodies.* Dated September 16, 1824.

Two methods are described in the specification of this patent, for propelling vessels. In the first the vessel is sloped from the middle of its bottom upwards to the stern, a little above the level of the water, and this slope is inclosed by a vertical partition lengthwise at each side, leaving the space at the stern open. In the lower part of the inclosure thus formed, are placed three horizontal frames, extending its whole length, moveable by hinges at the ends next the middle of the boat, and arranged so as to move freely up and down within the inclosed wedge-formed space described. The middle one of these frames is twice the breadth of either of the two outer ones, and each of them is furnished with six square valves, all moveable on hinges at their fore ends, but managed so that the four of each set which are next the stern open downwards to a certain extent, while the other two of each, which are next the middle of the boat, open upwards. These valves are so constructed, that they do not open more than in an angle of 45 degrees with the frames; and the frames also are fixed so that they cannot move further upwards than to bring these valves to a horizontal position. A steam engine, placed inside the vessel, is to move these frames up and down by rods ascending from their hinder extremities, in such a manner that the middle frame always is moved

in a reversed direction from the two outside ones. These frames with the valves are called paddles in the specification, and their intended mode of operation is to act obliquely on the water, in the nature of inclined planes, and by the reaction to impel the boat forwards. The intention of the two valves in each frame next the middle of the boat opening in a reversed direction from the rest, is to admit the water more quickly to replace that driven out by the action of the other valves of the paddles. The middle paddle is made twice the breadth of each of the others to balance their joint effect, and their moving in opposite directions, is in order to make the motion of the boat more steady.

The other method of moving vessels proposed, is by the supposed action of compressed air forced through a sort of trough at the bottom of the vessel, formed like the wedge-shaped inclosure of the lower part of the vessel first described (and sloped upwards from the middle of the vessel likewise, in a similar manner to the stern, where it is open also as that is), but which at the bottom is closed by a horizontal floor, which prevents the entrance of the water in that direction. A blowing cylinder, such as is used in some founderies, worked by a steam-engine inside the vessel, is to impel air into the extremity of this trough, which passing backwards to the stern, is there expelled into the sea; and the patentee supposes that by its being thus driven out in that direction, it will force the vessel forwards by the reaction of the water.

Of the first method for propelling vessels mentioned in this specification, we have to observe, that the action of inclined planes for this purpose was proposed so early as the year 1757, by the well-known Daniel Bernouilli; several other methods have since been published for their application to the same design, among which a very ingenious but complicated one was inserted in the 20th vol. of the Annales des Arts, a translation of which paper, con-

taining also an account of Bernouilli's plan, with a page or two of observations, will be found in the Retrospect of Arts, &c. Vol. I. p. 243.

The action of inclined planes is that which nature uses in producing the rapid motion of fishes; and it is also used largely by the Chinese in impelling vessels, some of which are of a considerable size, in the simple application of it in skulling, they sometimes using very large oars for the purpose, worked by six or eight men together. Some of the South sea islanders apply it also in a singular manner for the same purpose in their double canoes, from a frame in the centre of which they let down their paddles in a vertical direction, and work them to and fro across the frame, with the blades alternately reversed in their angular position towards the course of the canoe.

The want of success of the more complicated methods, which have been tried for this purpose, appears to have arisen from their having frames, and other parts belonging to them, moving in the water, which had no direct action in impelling the vessels, and which, by their resistance in the water, retarded their progress. The parts also which really acted, or the inclined planes, were in general too large in proportion to the power with which they were moved, from which defect they moved the water by a churning action, instead of impelling the boat. As it is evident the plan of the patentees, for applying inclined planes to this purpose, has both these imperfections, it cannot be expected that it will have much power for the design intended.

The method proposed for impelling vessels by compressed air, which is the second mentioned in the specification of this patent, seems an imperfect imitation of one published in 1815, by Mr. J. W. Boswell, for the same purpose (for which see Repertory of Arts, Vol. xxvi. p. 271), in which compressed air was made to act upwards on an inclined plane (formed at the lower part of the vessel, next the stern), with a force equal to the weight of water that

might be contained in the space which it occupied; or more precisely, with a force equal to the difference between the weight of a column of water, of the depth from the surface to the bottom of the space occupied by the air, and of the same base, and that of another column of the same depth and base, but composed partly of the compressed air, and partly of water, as will be found more particularly stated in the paper mentioned. The plan of the patentees has, indeed, an inclined plane, represented in the drawing of the trough or tube, into which the air is to be forced, the upper part of it being made in that form; but then the operation of the air on it as an inclined plane is entirely destroyed by the floor at the bottom of the trough, which prevents the pressure of the water from the bottom upwards on the air, and only admits it in a horizontal position from the stern, by which means the compressed air can only act from behind by the force with which it can be driven out there against the water, which, on account of its little specific gravity, and consequent very small momentum, will have but an extremely limited power to impel the vessel.

Patent granted to Timothy Burstall, *formerly of Bankside, Southwark, but now of Leith, and to* John Hill, *of Greenwich, now of Bath, Engineers, for a locomotive or steam carriage, for the conveyance of mails, passengers, and goods.* Dated February 8, 1825.

The peculiar contrivances used in this engine are classed under three heads in the specification; one of which relates to the formation of the boiler, another to the mode of supplying it with water, and the third to the general construction of the machinery.

The boiler is divided by upright partitions into several shallow compartments, which open above into a low space between them and the top, which forms a steam-reservoir. The fire-place beneath has a flue that passes under each

of these compartments in its way to the chimney. It is to be supplied with coals by a feeding machine, if the most perfect performance is desired, and is to have the air, which it will require, pressed into it by a blowing cylinder, which the patentees state will prevent the formation of dense smoke. The water is made to pass the boiler from a plate-iron reservoir, placed beneath the perch of the carriage, by two small air pumps, which force air into it, and by its pressure on the water cause it to rise through a copper tube into the boiler, round which the tube circulates through all the compartments, into each of which it has an opening for supplying it separately with water. The diameter of the air pumps is to be such as will cause them to make water pass equal to the consumption of the steam. They force the air in the first instance into a hollow metallic globe, placed above the water reservoir, in which there is a valve, pressed by a spring or weight, that permits such part of the air to escape as exceeds the quantity regulated by its pressure, and which of course is limited also by the height of the water in the boiler, though we think not expressly stated, by some of the methods in use for that purpose. The pressure is to be sufficient to confine the steam at a heat from 250° to 600°, Fahrenheit.

The water in the reservoir, and the coals in the receptacle for their supply, are to be replenished as wanted, at the stages where the carriage is to stop in its journey.

The boiler and furnace are suspended by horizontal springs behind the hind axle, from the frame-work of the carriage. The two working cylinders of the steam-engine are fixed before the axle, and act on it by two beams, which are put in motion by their piston rods, the other ends of which beams turn two cranks on the axle by the impelling rods which connect them; one of which cranks is at right angles to the other, to preserve the continued rotation of the axle, on the well-known principle practised in steam-boats. The piston rods are made to work perpendicularly by the parallel 'geer,' as it is called, commonly

used for this purpose, and the valves of the engine are shifted as desired in some of the usual modes. The steam is conveyed from the top of the boiler to the working cylinders, by a copper tube of due dimensions, which is made to bend round so as to form an entire vertical ring before it enters them, which the patentees assert will prevent its being broken, or its joints from being made to leak by the jolting of the carriage.

The carriage could be impelled by the motion of the hind axle alone in roads nearly level, but when they are of a nature to require the fore axle being turned also by the engine, then a shaft, placed beneath the perch, communicates the motion to it from the hind axle by bevel toothed wheels, in the manner common for such motions, a due regard being had to the horizontal motion of this axle, necessary for the direction of the course of the carriage, which is provided for by having a horizontal wheel, moveable round the centre of the linch pin placed above it, which the communicating shaft turns first, and from which the motion is continued to the axle by a vertical wheel attached to the latter.

The mode of giving motion to the two axles described, of course implies that the naves of the wheels must be fixed to them; but there is a particularity in doing this, that requires further explanation.

One of the wheels on each axle is fastened to it by a wheel or disk, with projections at its side, which correspond with similar projections on the inside face of the nave; and which, being constructed so as to slide towards or from the nave on a square part of the axle, by the intervention of levers, permit the wheel to turn freely on the axis, independent of the motion of the latter, or again connect them so as to move together when required; the use of which is, to admit of the two wheels at one side moving at times faster than the other two; which will be necessary when the carriage is to turn round, or when it is to move on a circular part of the road.

The apparatus for effecting the purpose described is called a "clutch wheel" by the patentees, and resembles those used for similar purposes in mills, in several different combinations, well known to mechanists.

A contrivance for retarding or stopping the motion of the wheels, necessary in descending hills, is also added, which causes segments of circles to press with great force on the naves of the wheels, by the medium of levers, properly disposed, which communicate with a pedal placed beneath the feet of the conductor, under the seat in front, by pressing on which he can stop the wheels when he pleases. A second pedal, in the same place, connected in a similar manner with the coupling apparatus above described, enables him to join the wheels mentioned to the axles, or disengage them, as he thinks proper. By the handles of two rods, placed also convenient to the seat of the conductor, one of which rods passes to the throttle valve of the steam pipe, and the other to a cock in the water pipe, he can, as is required, regulate the supply of water and of steam, and by the latter power increase or diminish the motion of the carriage, or stop it altogether.

The conductor also directs the course of the carriage: for this purpose his seat is placed in front, before the front wheels, as the most convenient situation; and directly before him is fixed a horizontal steering wheel, similar to those used in ships, which by intermediate wheels acts on a toothed segment of a circle, fixed beneath to the frame of the carriage, whose axis is concentric with that of the linch pin; and by turning which steering wheel to the right or the left, the conductor can cause the carriage to move to either side, as is necessary.

The patentees also describe an index, which they have contrived, to be placed near the steering wheel, by looking at which the conductor can ascertain the exact angle to which he should turn round the wheel; but we apprehend this instrument, however ingenious, would not be much required in practice.

In the drawings which accompany this specification, the body of a coach for passengers is represented, placed as usual, between the two axles of the carriage, and having fore and hind boots, similar to those of stage conveyances; but the patentees state that this part may be altered according to the uses for which the carriage is intended; and may of course be made like the body of a waggon, if designed for carrying mercantile goods.

The hind wheels are represented of large dimensions, and both they and the fore wheels as being furnished with metallic naves. It is stated also in the specification, that the toothed wheels, which are used to communicate the motion of the hind axle to the fore axle, should be so proportioned in size to each other, that they may cause the fore wheels of the carriage to move as much quicker round than the hind wheels as their peripheries are less, in order to make them operate equally on the road, and keep pace with their long-spoked neighbours.

This steam carriage, though apparently designed for common roads, may also be used on rail-ways, in which case it is evident the steering apparatus might be omitted, as the vehicles are guided on them by mere simple contrivances.

The patentees seem to have taken great pains to render this steam carriage as perfect as the knowledge as yet acquired, relative to this mode of conveyance, would permit; and the evident improvement which it exhibits on some of its predecessors, gives great hopes that the desirable object of making steam carriages capable of moving effectually on common roads, will be attained at no distant period.

The great impediment to the application of steam carriages to common roads, is their enormous weight, which in few cases, yet made public, has been much less than eight tons; to which, if the usual load of goods put on an

eight-horse waggon were added (to supply the place of stage waggons being one of the objects of the patentees), no common road yet made could support them. It would therefore be an object well worth that ingenuity which the patentees have shown in the construction of their steam carriage, to contrive means for lessening the weight of those vehicles in every possible way, as well as to pursue the plan already used on rail-ways, of having carriages for conveying the mercantile goods, or the passengers, quite distinct from that of the steam engine, which, for the latter purpose, would also be desirable for other obvious reasons; for, exclusive of the idea of danger, which sitting close to a caldron of boiling water, subject to be precipitated on them by an unlucky stone or rut in the road, might give to people otherwise not very timorous, the great heat of the furnace and boiler would be very objectionable, at least during the warm months. In this way the steam carriages would serve the purpose of horses to draw other carriages (which they so far resemble, that on the rail roads where they are used they are called, we are informed, *iron horses*, by the workmen); and for common roads this separation of the weight on separate carriages would be even much more necessary than for rail roads, on account of their being formed of materials so much less hard and durable. Among the methods proposed for making engines more light, that of using boilers constructed of small pipes seems very worthy of attention, several modes of which have been already made public; among the more recent of which, that for which Mr. Theodore Paul has lately obtained a patent (an account of which is inserted in our present Number), seems in some respects to deserve a preference; but requiring, in order to complete it, the addition of Mr. Perkins's patent principle, of confining the heated water in the pipes by a weighted valve, till the instant of its being let off to act on the piston of the engine in the form of steam; as the water without this would be blown

totally out of the pipes by the steam formed in its lower extremities.

The method of forcing the water into the boiler by the pressure of air, in an engine where no condensation is required, which is the case in that of the patentees, can do no injury to the general effect, and may be of some service on the principle applied in M. Latour's air engine (for which see Nicholson's Phil. Jour. vol. XXIX, p. 175), who caused a wheel to revolve by the expansion which the air received in passing from cold water into that heated to the boiling point; and as some of the air pressed into the patentees' water reservoir will be absorbed by the water, and pass over with it into the boiler, it will so far have a similar effect. It is also probable that the air pumps will keep longer and better in order than small water forcing pumps, both from air having less action on metal, and not being so liable to carry along with it extraneous substances.

It having seemed evident to us, that the name "*low-motive* carriage," given to that of the patentees, in their specification, may have arisen from a mistake of the copying clerk, for the word *locomotive*, we have altered it accordingly in the title. It seems proper, however, to notice, that the name is written "*low-motive*" in the title, and through all parts of the specification, where it occurs in that document, as examined at the enrolment office.

Patent granted to Joseph Apsdin, *of Leeds, Bricklayer, for a method of making lime.* Dated June 7, 1825.

This method of making lime consists in taking the "puddle" or "powder" of roads made of limestone, and drying it by the application of fire or of steam, or by exposure to the air, properly spread out; and when thus prepared, in burning it in a lime-kiln, according to the common method for making lime. After which, the pa-

tentee asserts, it will be fit to be used as lime, both for making mortar, with a due addition of sand, and for agricultural purposes.

In districts where good limestone is sufficiently plenty to be employed in making roads, it is most probable that the use of the road stuff, proposed by the patentee, would be no great object in saving expence. On the other hand, where it was not plenty, or where it was to be fetched from a great distance, it would be too costly to be employed in making roads.

It appears also that it would be extremely difficult to burn this limestone powder in a kiln, on account of its not having sufficient spaces between its particles for the admission of air to the fuel, by which it would burn badly, if at all, and would soon be extinguished.

As to agricultural purposes, it is doubtful if the limestone powder would be improved by burning it into lime. We have been where limestone gravel, or finely powdered limestone, was found naturally in beds beneath the soil, and there used to very good purpose for improving ground in the manner in which marl is employed; and it seems most probable, that the road stuff of limestone roads would be as good for manure as the limestone gravel, or indeed rather better, when it is considered how large a mixture of other species of manure there must be among it, from the passage of cattle, and the dropping of various matters on the roads from the loads carried over them.

Account of A Practical Treatise on Railroads, and interior communication in general, with experiments and tables of the comparative value of Canals and Railroads, by NICHOLAS WOOD, *Colliery Viewer.* 1 vol. 8vo. 314 pages.

Some Remarks on A Practical Treatise, by THOMAS TREDGOLD, *Civil Engineer, (on the same subject).* 1 vol. 8vo. 184 pages.

A few Observations on the pamphlets of Mr. H. R. PALMER *and Mr.* JOHN VALANCE, *on a Railway on a new principle, and on the expedience of sinking capital in Railways; and on locomotion by air drawn through an arched tunnel, &c.*

WE notice the above four treatises under one head, from their containing altogether most of the information which has yet been published respecting railroads, a subject at present of much public interest.

Mr. Tredgold's treatise must certainly be esteemed by far the most useful, from the great number of facts which he has collected, the perspicuous manner in which he has treated of them, and for the excellent tables which he has composed.

Indeed his work is of that masterly nature, that Mr. Wood might be thought somewhat indiscreet in publishing on the same subjects so soon after him; but of this he has altogether and well freed himself, having given valuable information on some points that had escaped the former author; corrected one of his very few errors, though a material one; added considerably to the number of facts and experiments on the same subjects, and increased the number of useful tables respecting them. His treatise may therefore be considered as a valuable appendix to that of Mr. Tredgold, clearly and cautiously composed, and in most respects well executed. Mr. Palmer and Mr. Valance being both patentees, and we having already given some observations on their plans in our Notices of New Patents, we should not notice their pamphlets here but for the reason before stated, and for the purpose of adding a very few words more respecting some other points contained in them, which have a bearing on the subjects treated of by the two preceding authors. Mr. Palmer's work indeed is more in the same line of the two first, as it contains a few

valuable facts and experiments on the more perfect formation of railways, and carriages for them, and on the friction of wheels and axles, and contains a table of the comparative value of the force of a horse, at 2¼ miles an hour, on six different railways; which, however, would have been much more satisfactory, had Mr. P. added to it a detail of the facts which led to the conclusions he has there inserted, and not confined the statement of his authorities to a single instance, but corroborated the evidence of the wonderful performance of his invention by some other testimony, in addition to his own assertion.

The chief error in Mr. Tredgold's treatise lies in his hasty condemnation of wrought iron rails, in which he has followed the opinions of Mr. Chapman, in his Report on the projected Railway between Newcastle and Carlisle; Mr. Wood takes the other side of this interesting question, in which he seems to have a decided superiority, both from the quotation he makes from the Report of Mr. G. Stephenson, of Newcastle, on the subject, and from the Reply to Mr. Chapman's Report, by Mr. Thompson, of Tindale Fell, averring that the malleable iron rails, which had been laid down there for sixteen years, had no appearance of lamination; and that the whole of the wrought iron which had been used there for that period, appeared to be very little worse; while the cast iron certainly was much worse, and subject to considerable breakage, although the rails of this metal are double the weight of those of the malleable iron. The waggons used on both those railways carried each a chaldron of Newcastle coals, or 53 cwt.

Mr. G. Stephenson's Report states, 1st, that wrought iron rails can be made cheaper than those of cast iron, from their requiring to be made only half the weight of the latter to afford the same security to carriages passing over them. 2d, That they admit of carriages moving with greater velocity on them, from their toughness rendering them less liable to fracture from a sudden impulse. 3d, They are more easily kept in order, one bar of them being

as long as several of the others, and thereby extending over a proportionally greater number of the blocks or pedestals; by which also these latter assist in keeping each other in their proper positions, while the joints being fewer, will enable carriages to pass more smoothly over them. 4th, The malleable iron rails are more regular in their wear, and on the whole will last longer than those of cast iron. Mr. G. S. here pointedly denies that wrought iron exfoliates, or separates into laminæ, in that part of them which is exposed to the pressure of the wheels, contrary to the assertions of some engineers (including Mr. Tredgold and Mr. Chapman), Mr. S. having closely examined rails which had been in use many years, with a heavy tonnage passing over them, and in no part of them having seen any appearance of such exfoliations. 5th, Mr. S. asserts that malleable iron will bear a pressure without injury which will "crumble down" cast iron. 6th, Malleable iron rails wear more equally; for those of cast iron have an external crust, harder than the rest, and when this is worn through, the decay of the rest becomes very rapid. 7th, The effects of the atmosphere are not so different on the two sorts as to be of much moment, Mr. S. having observed no oxidation, or crusting to any extent, on malleable iron railways. Mr. S. here notices a fact not easily accounted for,—"that malleable iron rails, subject to continued motion by the passage of carriages over them, are much less liable to rust than bars of the same metal, either standing or lying near them without being used; the latter continually throwing off scales of oxidated iron, while the former are scarcely at all affected."

We think the contradiction in these opinions on this important point, may be accounted for without imagining any intentional misstatement or neglect at any side, by merely supposing that Mr. Chapman and Mr. Tredgold contemplated one species of malleable iron, while Mr. Thompson and Mr. Stephenson examined another sort; the kind of wrought iron manufactured from scrap iron

having probably been that to which the two first-mentioned gentlemen alluded, while the two latter examined rails made of British bar iron, fresh from the furnace, in its first application from the ore. We have seen ship bolts, made at the Funtly Mills by rollers, from scrap iron, split in driving into a form resembling a bundle of wires, while we have seen specimens of the other sort much more subject to break than to bend or separate into filaments or laminæ. We have also seen very ancient iron palisades, swelled out by the action of the weather, and divided into numerous thin laminæ, like the leaves of a book; but have reason to think they were fabricated before the art of making wrought iron from the ore, by the use of coke from fossil coal, was practised here, having never seen an instance of bars of this latter fabric in a similar state. As far as our opinion then can be of use, it must be decidedly in favour of malleable iron rails.

Another matter in which it appears to us that Mr. Tredgold is mistaken, is in the great preference which he gives to large waggons with heavy loads, on railways, to those of a smaller size. Mr. T. on this occasion seems to have imbibed the old prejudice for voluminous and ponderous packages, evinced in those very imposing, but expensive road-grinding engines, the eight-horse waggons; which put the nation to more cost to repair the destruction which they cause to roads, than the amount of all their expence to their owners, much as that is. We believe Mr. T. would alter his opinion on this point, if he perused the strongly attested evidence in favour of single horse carts, in the Reports published in 1809, by the Committee of the House of Commons, on roads and wheel carriages; and if he saw how very adequate such carriages are in Scotland, where they seldom carry more than a ton weight, to all the purposes of a very extensive and multifarious commerce; or if he had known what has been done in this way, by carriages holding still less, in other countries. It is true that occasionally articles of extraordinary shape and di-

mensions will require conveyance on railways, as well as on other roads; but then it is obviously better to suit the carriages to the occasion, by combining two or more of them, so as to sustain the unusual load equally, than to lay down an expensive railway, of ponderous dimensions, for the accommodation of such casualties. The great and increasing extent of railways of a smaller species, with light carriages, in Wales, tends to confirm our opinions on this subject so much, that we are inclined to advocate the use of a still smaller sort, even what some gentlemen might think ridiculously small, carrying loads not exceeding ten hundred weight in the carriages, as the most economical, and which would yield the largest return of profit, at least where horses were used for the draft; but, where locomotive engines are to be employed for this purpose, their present ponderous forms might indeed make stronger railroads expedient, and this we imagine to be the only case in which they would be necessary.

Mr. Tredgold has noticed Mr. Palmer's patent railway, of which we have given some account in our last Number. In recommending a species of it ten feet high on level ground, we think he does not much serve this speculation, since this form would greatly add to its expence, and to the liability to lateral derangement of the pillars, which are the most objectional points in the contrivance; and would moreover considerably increase the draft of the horses used with them, as the downward draft caused by this arrangement would not only add to the pressure of the load on the rail, but otherwise increase the difficulty, by the awkward, and indeed dangerous direction in which it would cause the collars to press on their necks. Iron railways of this latter description must be out of the question, nor indeed do we think any kind of them of this metal would be as cheap as the common edge rails, as explained in our last Number; but in some situations, where durability is not a prime object, a wooden railway of this sort might be advantageous, for which consider-

tion they would be very suitable for Russia, America, and other countries where timber is cheap; and indeed if the pillars were made more durable by the method proposed in our notice of Mr. P.'s patent, of having their central parts at the level of the ground defended by cast iron sockets, with the farther addition of cast iron heads or caps, furnished with socket joints in a similar manner, the plate of iron at top made to overhang the wood a little to throw off the rain, and all the wood work well painted; such a railway might perhaps last long enough to pay very well in many places, even in this country.

In thus differing on two or three points from Mr. Tredgold, we by no means intend to derogate from the value of his work, in the respects which we have before mentioned; and as there will be doubtlessly more than one edition of so useful a publication, and as he cannot desire to confine its perusal to one class of readers, who are far from being numerous, we hope he will excuse our recommending him to separate his algebraical calculations from the text in the next edition, by placing them either in an appendix, or inserting them in the form of notes; an alteration which will much extend the usefulness of the work, and cause it to be read with pleasure by many who would not endure the labour of going through these difficult premises, though they might be well pleased to know the conclusion, a task by no means agreeable even to expert algebraists, whom we have reason to think seldom give themselves the trouble of reading calculations of this sort, where they have no intention themselves of writing on the same subject.

Mr. Wood has cautiously abstained from giving any opinion relative to the plans for rail-roads of an unusual construction; and has founded his conclusions respecting the superiority of the edge railways over tram rails on a very careful examination, and the collection of well proved facts; he much discountenances the exaggerated expectations that lately prevailed very generally, of the great velocity with which carriages could be moved on them by

steam engines, in which opinion Mr. Tredgold coincides: he thinks railways and locomotive engines will hereafter receive great improvement, so as to be much more efficacious for the same expence; and points out some circumstances on this head which will probably much accelerate their alteration for the better. In comparing the relative value of canals and railways, among other excellent observations, he states, that when a velocity of four miles an hour is required, the conveyance by railways will have a decided superiority; but that at the rate of two miles an hour, more work can be done on canals; and concludes with recounting many particulars which give railways a decided superiority.

In a work so well executed in general, it is with some reluctance that we proceed to notice any defects; they are, however, but few, and are easily rectified.

We were surprised to perceive that a gentleman so well informed as Mr. Wood, should retain the old error of friction depending on the *extent* of surface of the bodies in contact. Desaguliers, in his lectures more than 90 years ago, had clearly proved the error of this idea, as have many writers before him, and all who treat of such subjects since. Yet Mr. Wood seems so impressed with this notion, that he repeatedly accounts for the greater friction produced on certain occasions, from the greater extent of rubbing surfaces under the same pressure; and this even after relating an experiment which ought to have proved to him his mistake, in which a waggon, with bearings on the axles four inches broad, required considerably less force to move it than those with brass bearings one inch and a half in breadth, carrying equal loads.

Some verbal errors we would also desire to correct, lest the example of a respectable author should add weight to a wrong use of words, which in many instances has already tended too much to impare the accuracy of our language. In the first place we object to his giving the appellation of a *diagram* (in p. 181) to the statement of the

value of the circumstances on which the aggregate amount of power required to drag a body over a given space depends; *diagram* being a word which, both from its Greek derivation and its general application, denotes a geometrical figure, such as those in Euclid's Elements.

In the account of his dynometer he has named the weight appended to it a *pendulum*, which, as it performs no office similar to the regulating part of a clock, to which this word is appropriated, we think also should be corrected; for if this licence is allowed, we may talk of the pendulum of a bell when we mean the clapper, or that of a pump to denote the handle, both of which resemble a pendulum full as much as the weight of Mr. W.'s dynometer.

And lastly, we think his denominating the pressure of steam its *weight*, which he does repeatedly, as if the two words were synonymous terms, ought to be amended, since steam has its weight as well as any other substance, and in this respect ranks between atmospheric air and hydrogen gas.

Mr. Valance's pamphlet is to be recommended for the statement it contains of the comparative value of locomotive and stationary steam engines in impelling carriages; and if he estimates the latter at a higher rate than is done by Mr. Tredgold and Mr. Wood, it is to be recollected that in his computation he considers them as being unencumbered with the heavy friction of ropes or chains, drawn along for great distances, which the other two gentlemen were obliged to take into the account in their statements. Indeed it is probable that one of the circumstances in which railway conveyance will be most improved hereafter, will arise from employing better modes of communicating the impulse of stationary engines to carriages; for which purpose we have already another very ingenious method, besides that of Mr. Valance, proposed by Mr. James in the specification of his patent, of which we give an account in the present Number.

LIST OF NEW PATENTS.

Charles Friend, of Bell Lane, Spitalfields, Middlesex, sugar refiner, for improvements in the process of refining sugar.—Dated July 26, 1825.—Six months to enrol specification.

John Reedhead, of Heworth, Durham, Gentleman, for improvements in machinery for propelling vessels of all descriptions, both in marine and inland navigation.—Dated July 26, 1825.—Two months to enrol specification.

John Edward Brooke, of Headingly, near Leeds, woollen manufacturer, and James Hardgrave, of Kirkstall, of the same place, woollen manufacturer, for improvements in or additions to machinery used in scrubbing and carding wool, or other fibrous substances.—Dated July 26, 1825.—Six months to enrol specification.

David Oliver Richardson, kerseymere and cloth printer, and William Hirst, manufacturer, both of Leeds, for improvements in the process of printing or dyeing woollen and other fabrics.—Dated July 26, 1825. Six months to enrol specification.

James Kay, of Preston, Lancashire, cotton spinner, for machinery for preparing and spinning flax, hemp, and other fibrous substances, by power.—Dated July 26, 1825.—Six months to enrol specification.

Richard Witty, of Sculcoates, Yorkshire, civil engineer, for an improved chimney for Argand and other burners.—Dated July 30, 1825.—Six months to enrol specification.

Joel Lean, of Fishpond House, near Bristol, Gentleman, for a machine for effecting an alternating motion between bodies revolving about a common centre or axis of motion; also certain additional machinery or apparatus for applying the same to mechanical purposes.—Dated July 30, 1825.—Six months to enrol specification.

The Rev. William Barclay, of Auldeare, Nairnshire,

for an improved instrument to determine angles of altitude or elevation, without the necessity of a view of horizon being obtained.—Dated July 30, 1825.—Two months to enrol specification.

Richard Badnall, the younger, of Leek, Staffordshire, silk manufacturer, for improvements in the manufacture of silk.—Dated July 30, 1825.—Six months to enrol specification.

Samuel Bagshaw, of Newcastle-under-line, Staffordshire, Gentleman, for a new method of manufacturing pipes for the conveyance of water and other fluids.—Dated August 8, 1825.—Two months to enrol specification.

George Charleton, of Maidenhead Court, Wapping, and William Walker, of New Grove, Mile-end Road, Stepney, master mariners, for improvements in the building or constructing of ships or other vessels.—Dated August 10, 1825.—Six months to enrol specification.

Samuel Lord, James Robinson, and John Forster, of Leeds, Yorkshire, copartners, merchants, and manufacturers, for improvements in machinery for and in the process of raising the pile on woollen cloths and other fabrics, and also in pressing the same.—Dated August 11, 1825. Two months to enrol specification.

William Hirst, Henry Hirst, and William Heycock, woollen cloth manufacturers, and Samuel Wilkinson, mechanic, of Leeds, Yorkshire, for an apparatus for preventing coaches, carriages, mails, and other vehicles, from overturning.—Dated August 11, 1825.—Six months to enrol specification.

John Stephen Langton, of Langton Juxta Partney, Lincolnshire, Esq. for an improved method of seasoning timber and other wood.—Dated August 11, 1825.—Six months to enrol specification.

Jacob Perkins, of Fleet-street, London, engineer, for improvements in the construction of bedsteads, sofas, and other similar articles. Communicated to him by a foreigner. Dated August 11, 1825.—Six months to enrol specification.

Henry Richardson Fanshaw, of Addle-street,

London, silk embosser, for an improved apparatus for spinning, doubling and twisting, or throwing silk.—Dated August 12, 1825.—Six months to enrol specification.

James Butler, of No. 64, Commercial Road, Lambeth, Surrey, for a method of making coffins for the effectual prevention of bodies being removed therefrom, or taken therefrom, after interment.—Dated August 12, 1825. Two months to enrol specification.

Marc Lariviere, now residing at No. 21, Frith-street, Soho, Middlesex, mechanicean, late of Geneva, in Switzerland, for a machine for perforating metal plates of gold, silver, tin, platina, brass, or copper, being applicable to all the purposes of sieves, hitherto employing either canvas, linen, or wire.—Dated August 15, 1825.—Two months to enrol specification.

Joseph Alexander Taylor, of Great St. Helen's, London, Gentleman, for a new polishing apparatus for household purposes.—Dated August 13, 1825.—Six months to enrol specification.

Charles Downing, of Bideford, Devonshire, Gentleman, for improvements in fowling-pieces and other fire-arms.—Dated August 15, 1825.—Two months to enrol specification.

Andrew Shoolbred, of Jermyn-street, St. James's, tailor, for improvements on, or a substitute for, back stays and braces for ladies and gentlemen, chiefly to prevent relaxation of the muscles.—Dated August 18, 1825.—Six months to enrol specification.

Philip Taylor, of the City Road, Middlesex, engineer, for improvements in making iron.—Dated August 18, 1825.—Six months to enrol specification.

Peter Williams, of Leeds, and James Ogle, of Holbeck, Yorkshire, cloth manufacturers, for improvements in fulling mills, or machinery for fulling and washing woollen cloths, or such other fabrics as may require the process of felting or fulling.—Dated August 20, 1825.—Six months to enrol specification.

THE

REPERTORY

OF

PATENT INVENTIONS, &c.

No. IV. OCTOBER, 1825.

Specification of the Patent granted to THOMAS HOPPER, *of Reading, in the county of Berks, Esq. for certain improvements in the manufacture of silk hats.* Dated November 20, 1823.

TO all to whom these presents shall come, &c. *Now know ye,* that in compliance with the said proviso, I, the said Thomas Hopper, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in the following description thereof, (that is to say):—*Method of manufacturing the New Patent Silk Hats.*—The woollen substance which forms the basis, is first to be boiled in a solution of the supersulphate of alumine and potass (common alum) for about two hours, in the proportion of two or three pounds of alum to a gallon of water. It is then to be taken out, well rinsed in clear water, and wrung, and immediately dipped in a solution of isinglass or glue, of variable strength, at a boiling heat, and put on a frame to dry, and give it a shape. The cloth thus prepared, and before, or when it becomes quite dry, may be again immersed in a strong solution of acetate or tartrate of alumine, (the acetate

thus made,—alum about three pounds, sugar of lead one pound, dissolved separately in a gallon of water, and then mixed and decanted :—the tartrate thus made,—dissolve about two pounds and a half of alum, and one pound and a half of cream of tartar, in a gallon of boiling water ; this need not be strained) or supersulphate, and allowed to remain in the liquor for a few hours ; it may then be rinsed and dried as before. This liquor must not be hot. A third method is, to dip the cloth (previously alumed) in a solution of gelatin, and one of the aluminous salts, added together ; when wrung, immerse it once or twice in an alkaline lixivium ; afterwards dry as before. By these processes the gelatin is set or fixed in what may be termed the first, second, and third degree, and the manufacturer may use the first singly, or combined with the second, as directed, or the third only. In the last process, a double chemical change is effected ; the acid of the aluminous salt leaves it, and attaches itself to the alkali, while its base, the alumine, combines with the gelatin, renders it insoluble in water, and together with it remains affixed to the cloth. Various important advantages appear to be derived from the alumining process. It effectually removes the grease from the wool, by which, conjoined with its strong affinity for the cloth and gelatin, between which there exists but little naturally, it acts as a powerful intermedium in fixing the latter,—enables it to resist the action of water, from the absorption of which, when used in its simple state, and consequent increase of volume, appears to rise one of the principal causes of the disjunction and falling to power of the resinous gums. It prevents the cloth from shrinking in any sensible degree, when subsequently wetted ; facilitates the adhesion of the gums with the wool ; and serves to equipoise those materials that are fusible by heat. The resinous gums may now be applied in the same manner as at present practised, or they may be used in the humid way, dissolved in a

spirituous menstruum, with a proportion of Venice turpentine. It is usual to mix a third or fourth part of resin or sandarack with the lac; but the mastiche is preferable, not curling up in cooling like the sandarack, and possessing more tenacity than either. It contains a substance analagous to caoutchouc. Caoutchouc, or elastic gum, dissolved in rectified oil of turpentine, and rendered drying by pure alumine, by washed æther, or which is more economical, as much acetate of alumine as it will absorb; they should be rubbed together. It is intended for the rim, but a discretion is left with the manufacturer in its application. Between the resinous gums and the varnish, an intervening substance, not fusible by heat, is necessary to prevent the latter from subsiding. Isinglass dissolved in weak spirits, gum acacia, simple or pure aluminous paste, &c. suffice; the pure alumine is also used inside, mixed with common or resinous paste; pure alumine is obtained by pouring on a solution of alum, a solution of potass, soda, or ammonia, washing the precipitated powder once or twice with boiling water, and after filtering, drying the powder. The varnish, either that in common use, or the following, may be employed—asphaltum four parts, gum mastiche or amini two or three parts, drying linseed oil from two to three parts; melt the bitumen and gum in an iron vessel over a charcoal fire, then add the oil; when well mixed, remove the vessel from the fire, add Venice turpentine two parts, and, gradually, six or eight parts of essential oil. Strain; if it should be too thick, when cool add more of the essential oil. The proportions here given, admit of being varied.

In witness whereof, &c.

Note. The preceding specification has been carefully compared with the record in the Enrolment Office, of which it is a correct copy.

Specification of the Patent granted to Jacob Perkins, *late of Philadelphia, in the United States of America, but now of Fleet-street, in the city of London, Engineer, for certain improvements in steam engines, in part communicated to him by a foreigner residing abroad.* Dated June 5, 1823.

WITH A PLATE.

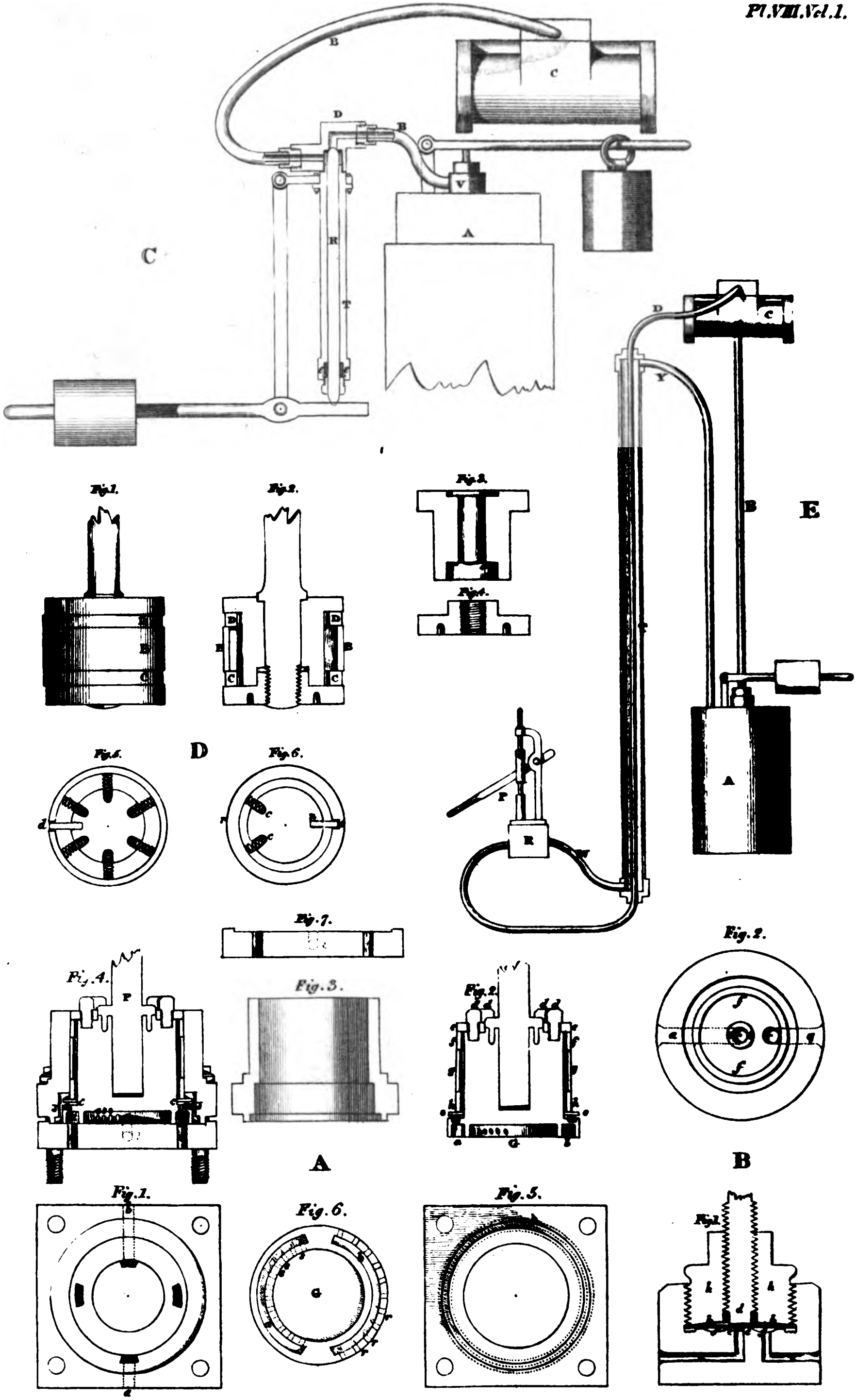
TO all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said Jacob Perkins, do hereby declare my said improvements to consist, First, of an improved rotary valve; Second, of a new valve to serve as a throttle valve; Third, of a new application of a loaded valve; Fourth, of a new arrangement of rings for metallic stuffing; Fifth, of a new condensing apparatus. And that the nature of my said first improvement of an improved rotary valve doth consist in reducing the friction caused by the action of the steam on the upper surface of the revolving plate now in use in rotary valves, by substituting a revolving plug in lieu thereof, and opening the upper surface of such a plug to the atmosphere. It should here be stated that when I say the upper surface of the plate or plug, I suppose the valve to be in a horizontal position. And that the nature of my second improvement, of a new valve to serve as a throttle valve, doth consist in opening and closing the passages for the steam, by means of the elasticity of a metallic plate, acted upon indirectly by the governor. And that the nature of my said third improvement, of a new application of a loaded valve, doth consist in creating pressure upon the steam generated for the purposes of the engine, which pressure must be overcome by such steam itself, before such steam can act upon the piston or reach the cylinder. And that the nature of my said fourth improvement, of a new arrangement of rings for metallic stuffing, doth consist in keeping the expanding opening of the flexible ring steam tight, by means of eccentric and

non-expanding rings. And that the nature of my said fifth improvement, of a new condensing apparatus, doth consist in condensing the steam in the eduction pipe, as it leaves the cylinder, by forcing the supply water, cold or at a low temperature, round, and along a considerable surface of the said eduction pipe, in such manner as to keep such supply water always under pressure. And in further compliance with the said proviso, I, the said Jacob Perkins, do hereby describe the manner in which my said several improvements are to be performed, by the following descriptions thereof, reference being had to the drawings and figures annexed, that is to say:—As regards my said first improvement, of a new rotary valve, it is described by the drawing marked A, (Pl. VIII). Fig. 1 is a plan of the main or fixed plate of a rotary valve now in use; *a* representing the situation of the induction, and *b* the situation of the eduction pipe; and *c*, *e*, the channels leading into and out of the cylinder. Figure 2 is a section of my improvement, which I substitute for the revolving plate now in use, and is in fact a revolving plug, furnished with my improved metallic stuffing, hereinafter more particularly described: *f*, *g*, *h*, are the three rings of the said metallic stuffing, and are kept up to the rim, *e e*, at the top of the plug, by means of the support ring, *c c*, which is acted upon by the spiral spring shown under it: *d*, *d*, *d*, *d*, are screws to fasten down the collar, *e e*: *a*, *b*, are two channels for the steam, which by the rotary motion of the plug are opened alternately to those openings shown in figure 1, at *c* and *e*. One of the principal properties of this plug is, that by its peculiar construction, the steam which in the revolving plate now in use presses wholly on the upper surface, and thus creates an increased friction, according to the force of the steam, is allowed in my improved valve to pass from the induction pipe round the outside of the plug, filling the space, J J, figure 4; from this space it finds its way through the holes at *r*, through the passage, *b*, into the passage, C, and so into the cylinder.

Having performed its duty in the cylinder, the steam passes out of the cylinder by the passage, *e*, into the passage, *a*, and thence through the holes, *s s s*, into the chamber, G, whence it escapes into the eduction pipe, *b*. Figure 6 is a plan of the under surface of the said plug; *a*, *b*, are the two passages for the steam, and it will be seen that the passage, *a*, communicates with the centre space or circular chamber, G, by means of holes, *s s s*, and that the outside of the plug communicates with the passage, *b*, by means of holes at *r*, *r*, *r*. By this arrangement it will be seen that the steam in the chamber, *a*, and the chamber, G, will be pressing the plug upwards, while the steam that is suffered to enter into the space, J, figure 4, on its way into the passage, *b*, passes round the outside of the plug, but is still confined in the outer casing of the plug, and will therefore press the plug downwards, by acting on that part of the plug immediately under the support ring, *c c*, in an equal proportion, or nearly so, as the steam in the chamber, G, and passage, *a*, is pressing it upwards, thus destroying or rather neutralizing the excess of friction which would otherwise be created by an increase of force in the steam. The plug receives its rotary movement through the medium of the shaft, P, which is furnished with a cogged wheel or other apparatus for that purpose. Figure 5 is a plan of figure 3, and figure 7 is a section of figure 1, and figure 3 is a section of the outer casing of the plug or stuffing box, shown by itself; and the outer casing or stuffing box being open at its upper surface, it will seem that the upper surface of the revolving plug, passing through and above it, is of course open to the atmosphere, and subject therefore to the pressure of atmospheric air only, and not of steam, as is the case in the upper surface of the revolving plate now in use in rotary valves. And as regards my said second improvement of a new valve, to serve as a throttle valve, it is described by the drawing marked B. Figure 1 is a section of the said valve: *d* is a screw acted upon by

the governor, and working in the screw plug, *h h*, the bottom of which plug it will be observed is concave: *b b* is a thin flexible plate of steel or other metal, acted upon by the end of the screw, *d*, which action presses the steel plate so tightly down upon the flat surface, *e e*, that no steam can escape from the passage, *a*, while it remains in this position. When the action of this screw is removed from the plate, *b b*, it rises from the flat position which it assumes in this figure up into the concavity at the bottom of the screw plug: *a*, *q*, are passages connected with the steam pipe, and *f f* is a circular communication passage, by which the passage, *q*, is fed, when the steel plate, *b b*, rises. By this arrangement it will be seen that in the position which the steel plate, *b b*, is represented in this figure to assume, all communication is stopped between the passages *a* and *q*; but if the screw, d, were raised, the steel plate, *b b*, would immediately rise by the under action of the steam, and a communication would be at once formed between passages *a* and *q*, by means of the circular passage, *f f*. Fig. 2 is a sectional plan of part of my said second improvement, showing more clearly the relative situations of the passages *a* and *q*, and *f f*. And as regards my said third improvement, of a new application of a loaded valve, it is described in the drawing marked C. In this drawing A represents a patent generator, with its loaded valve, V, and B B the steam pipe communicating with such valve at one end, and with the cylinder, C, at the other end; at D in the steam pipe is a loaded valve, the nature of which is sufficiently explained by the drawing, except that it is necessary to state that the rod or plunger, R, fits sufficiently loosely in the tube, T, to allow of water rising round it in the tube to its upper extremity, or nearly so. This water being pressed upon by the steam above it, will keep the leather or other collar at *e e*, tight or close round the lower extremity of the rod R, which is so long as to prevent the water getting sufficiently heated to destroy the leather. It will be seen

by this arrangement that the steam generated by the generator before it can pass into the cylinder, must force open the loaded valve at D by its own power, and cause thus pressure upon or interruption of the steam, previous to its entering the cylinder, being in fact the substance of my said third improvement; it will be proper here to state that the application of a loaded valve, interposed between the steam chamber of an ordinary steam boiler and the cylinder, will answer the same purpose; my said third improvement, therefore, does not embrace any novelty that may be in the particular loaded valve described in the said drawing marked C. And as regards my said fourth improvement, of a new arrangement of rings for a metallic stuffing, it is described by the drawing marked D. Fig. 1 is an elevation of a piston, with my improved metallic stuffing, B being the flexible expanding ring now used for metallic stuffing, and C, D, the two inflexible and non expanding rings, which constitute my said fourth improvement. Fig. 2 is a section of fig. 1, and figs. 3 and 4 are sections of the different parts of the piston head, shown separately. Fig. 5 is a plan of the flexible expanding ring now in use for metallic stuffing. By an examination of this ring it will be seen that there is an opening at *d*, and to prevent the escape of steam at this opening, I place the two rings marked C, D, in fig. 1, one on each side of the flexible ring. Fig. 6 is a plan of one of the said two rings, which will be sufficient to explain, as they are both alike: N is a guide pin, on which the notch cut in the ring at *e* moves loosely: C, C, are two spiral springs, which press the side of the ring to which they are attached, *r*, eccentrically from the piston. When these two rings are fitted on the piston, the part, *r*, should be arranged to come directly over the open part, *d*, of the flexible expanding ring; and it will be seen by this arrangement, that when the piston is put into the cylinder, these two eccentric rings, C and D, fig. 1, will press against that part of the cylinder immediately above and


C
E
D
A
B
Fig.1.
Fig.2.
Fig.3.
Fig.4.
Fig.5.
Fig.6.
Fig.7.

below the opening in the elastic ring, B, and will thereby supply the deficiency occasioned in the piston by such opening in the elastic ring; and reversing the action of the parts above described, the same may be equally well applied as a stuffing for the piston rod. And as regards my said fifth improvement, of a new condensing apparatus, it is described in the drawing marked E. In this drawing, A is a patent generator or steam boiler, with its loaded valve: B is an induction pipe, leading from the patent generator to C, which is supposed to be the cylinder: D is an eduction pipe which passes through the tube, T, and thence into a reservoir or well, R. This reservoir or well feeds the forcing pump, P. The pipe marked W is a pipe leading from the forcing pump into the tube, T, and the pipe marked Y, being a continuance of W and T, is the supply pipe to feed the said patent generator. With this apparatus the operation of condensing is performed, in the following manner, (that is to say):—The steam generated by the said patent generator, passes by the induction pipe, B, into the cylinder, C, at a very high temperature, and leaves the cylinder after having performed its duties there, at nearly the same temperature, by the eduction pipe, D. While the steam is passing through the part of the pipe which is encircled by the tube, T, cold water from the reservoir or well, R, is pumped through the tube in a contrary direction, by means of the forcing pump, P. The effect of this operation will be, that the steam in the eduction pipe will be condensed, and will run in the form of water into the well or reservoir, R, while the cold water, by passing through the tube, T, becomes heated, and in that state passes out of the tube, T, by the pipe, Y, and thence into the said patent generator. Now whereas I do not claim to be entitled to exclusive privilege to any such parts of machinery or apparatus as are described in my several descriptions of the drawings hereunto annexed, to be now in use, nor to the said generator and loaded valve, therein described to be patent; but a rotary valve, so improved as aforesaid;

and also a valve to serve as a throttle valve, on the principle aforesaid; and also my said new application of a loaded valve, constituting an apparatus for the purpose of creating pressure on the steam generated for the purposes of the engine, which pressure must be overcome by such steam itself before such steam can act upon the cylinder, or reach the piston; and also an arrangement of rings for metallic stuffing, on the principle aforesaid; and also a condensing apparatus, on the principle aforesaid; being every and each of them, to the best of my knowledge and belief, entirely new, and never before used in these kingdoms, nor in any of His Majesty's colonies or plantations abroad. I do hereby declare this to be my specification of the same, and that I do verily believe this my said specification doth in all respects fully, and without reserve or disguise, comply with the said proviso, in the said in part recited letters patent contained; and I do therefore hereby propose to maintain my exclusive right and privilege to the same.

In witness whereof, &c.

Specification of the Patent granted to DAVID GORDON, *of Edinburgh, at present residing at Stranraer, Esquire, for certain improvements in the construction of harness for animals of draft and burthen.* Dated September 8, 1821.

TO all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said David Gordon, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in the following description thereof, (that is to say):—My improvements consist in the application of helical or screw-like springs, fitted up in iron or other metallic or unyielding tubes, somewhat in the manner of spring steel-yards, to those parts of harness termed traces, hame tugs, pole pieces, backbands, or breechings; and

they may either be inclosed within the leathers forming those parts of the harness, or not, as may suit the fancies of the persons using them. If in the long traces, used in drawing stage coaches, gentlemen's carriages, curricles, gigs, &c. I place the springs far enough behind the horses, so as not to rub against their sides. When the horses draw by what are commonly called hame tugs or earing chains, the springs should be placed close to the hames; and this is particularly necessary to be attended to, when two or more horses are drawing in one line, so that the draught of one horse only should act upon one set of springs. I do not intend hereby to confine myself to any particular strength of the springs, but I recommend that each trace should have a spring or springs attached to it, capable of drawing from one to two hundred pounds weight, the utmost power of a horse being, I believe, less than equal to four hundred pounds. The advantages I propose from the employment of these springs in the traces are, the facilitating the draught, and the preventing of sudden checks or jerks, and thereby avoiding shaking or galling the shoulders of the horses, and also contributing to the ease and comfort of the passengers; and when added to the breechings or pole pieces of harness in general, they also afford a farther relief to the horses.

In witness whereof, &c.

Specification of the Patent granted to PIERRE JEAN BAPTISTE VICTOR GOSSET, *of Clerkenwell Green, Middlesex, Merchant, for certain improvements in the construction of looms or machinery for weaving various sorts of cloths or fabrics.* Dated December 18, 1824.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said Pierre Jean Baptiste Victor Gosset, do hereby

declare the nature of my said invention by the following description thereof, and the manner in which the same is to be performed and carried into effect, by the drawing which is hereunto annexed, reference being thereunto had, and to the figures and letters marked thereon as follows, (that is to say):—My said improvements relate to that part of looms or weaving machinery which is usually denominated the shuttle, being the implement or apparatus which contains the yarn or material employed to form the woof or weft of the cloth or fabric.

In shuttles such as are at present known and in use, great difficulties have been experienced in causing the thread or yarn to come off the bobbin or shuttle cap with a uniform tension, without which it is almost impossible to produce a good and even cloth; but by my improved form and construction of shuttle, and disposition of the bobbin therein, I am enabled to apply a regulating spring, for the purpose of creating the necessary resistance upon the bobbin, which said spring is furnished with an adjusting screw, by which the power of the spring may be increased or diminished at pleasure, thereby insuring a proper degree of tension upon the yarn at all times. Fig. 1 (Pl. IX.) upon the annexed drawing represents a plan of a shuttle, constructed according to my improvements. Fig. 2 represents an edge section, and fig. 3 a transverse section, supposed to be taken near the middle thereof. This form of shuttle is particularly adapted to the weaving of cloths, or fabrics composed of metallic wire, or other stiff and unelastic materials. A A represent the body of the shuttle; it may be formed of wood or other suitable material, and tipped or pointed at its extremities with metal, in the ordinary manner: B B show the opening which is made in the side thereof, in order to receive the bobbin or weft roller, C, which is formed with flanges in the manner of a pulley, and is adapted to turn correctly upon a pin or wire, *a*, which said pin passes through the top and bottom of the shuttle; by withdrawing the pin, *a*, the bobbin may

be taken out and replaced again with great facility: D D represent the regulating spring: it is formed of steel or other sufficiently elastic material, and is affixed to the shuttle at each of its extremities, by being turned down and driven into the wood, or it may be fixed to the shuttle in any other convenient manner.

This regulating spring is shown separately upon a larger scale at fig. 4 upon the drawing; it is furnished with a second or small curved spring, at *d*, which is adapted to bear and press upon the upper surface of the bobbin, as will appear evident from inspection of fig. 2.: *e* shows a small adjusting screw, the head of which is intended to be inserted or sunk into the upper part of the regulating spring, D D, in order to prevent its becoming entangled with the threads or yarns of the warp in its passage across the same during the act of weaving. The lower extremity of the adjusting screw is adapted to work into a small nut or female screw, *h*, which is supposed to be firmly fixed into the wood forming the shuttle, so that by turning the said screw round the part, *d*, of the regulating spring, may be caused to press with more or less force upon the upper surface of the bobbin, and thereby create a greater or less degree of resistance for regulating the tension at which the yarn or thread shall be drawn off the circumference of the bobbin, and through the eye, *c*, of the shuttle. I generally line that part of the shuttle upon which the bobbin rests with a plate of metal or other substance, having an even surface, in order that the resistance against the under surface of the bobbin may vary as little as possible.

It will appear from inspection of fig. 3, that the upper and lower surfaces of the shuttle are formed concave, in order that the head of the adjusting screw, *e*, of the regulating spring, D D, may not project so as to injure or entangle the yarns of the warp during the passage of the shuttle; and in some cases I find it convenient to place the spring within the opening, B B, of the shuttle, leaving a small round hole in the upper part thereof, for the pur-

pose of introducing a turn screw or instrument to the end of the adjusting screw, when it is required to increase or diminish the power or resistance of the regulating spring upon the bobbin.

In some constructions of shuttles it will be found advisable to have no opening in the edge of the shuttle. This I effect by forming the shuttle like a box, with a lid sliding in grooves or otherwise hinged on, being provided with a catch or fastening, so that the said lid may be opened or removed when it is desired to take out the bobbin and replace it by another. In this construction the regulating spring, with its adjusting screw, may either be fixed upon the said lid, or it may be situated in the opposite or fixed side of the shuttle.

In weaving articles of stiff wire, with my improved shuttles, I find it advisable to employ a casing or tube of some elastic substance, to surround the bobbin, as seen by dotted lines in fig. 2. This tube is not quite entire, but has an opening or slit down the side thereof, for the wire to pass through; and by closely encompassing or embracing the bobbin at every part except the slit, it prevents the coil of wire upon the circumference of the bobbin from unwinding or recoiling, and becoming loose or entangled, and allows it to be drawn off evenly or regularly, in proportion as it may be required to form the cloth or fabric; and when the metallic wire desired to be woven is stiff and hard, I occasionally employ a small pair of tempered steel rollers in the side of the shuttle, at about the place where the small eyes, *c*, are represented, by which means the wire runs out with considerably less friction. Figs. 5 and 6 represent another description of shuttle, constructed according to my improvement. This form of shuttle would be applicable to the weaving of cloths, or fabrics of silk, or any other material: A A show the body of the shuttle; it is hollowed out from the edge at B B, as above described, with reference to the former figures. This shuttle is provided with three separate bobbins or pulleys, to contain

thread or yarn, as seen at c c c, which bobbins may either be worked one after the other with the same coloured yarn, or other different coloured yarn may be wound upon each of the bobbins for weaving figured goods. Thus, when a change of colour in the weft is required, it will be only necessary to break off the end of the yarn which was done with, and suck or draw the end of the other colour through its respective opening or eye, as seen at *c c c*. These bobbins are supposed to be constructed like pulleys, with two broad rims or flanges, in the same manner as above described, and to be each provided with its regulating springs, D, and adjusting screw, *e*, in order to regulate the tension at which the yarn should come off from the circumference thereof. The springs, D, are represented in figs. 5 and 6 as fixed to the shuttle by one of their extremities only; but they might be affixed at each extremity, and made to bear upon the bobbins by a small curved spring, as hereinbefore described. When the regulating springs are fixed, as shown in figs. 5 and 6, I generally turn the loose end, or that end which bears upon the bobbins slightly downwards, and allow it to enter beneath the surface of the wood forming the shuttle, by which means the extremity of the spring is effectually prevented from becoming entangled with the yarns of the warp, in its passage across the same.

It is not essential that three bobbins only should be used in one shuttle; but a greater or less number may be employed, as circumstances require.

I have now described with reference to the annexed drawing, my said invention for improvements in shuttles, which form part of a loom or machinery for weaving various sorts of cloths or fabrics; and I hereby declare that my invention consists in the peculiar form and construction of shuttles for weaving, which I have hereinbefore described, and are represented in the figures upon the annexed drawing; the said peculiarity in construction

being that the bobbin upon which the thread or yarn is wound is made in the form of a wheel or pulley, and is situated and placed upon a pin or axis, which said axis or pin remains in a vertical position when the shuttle is in use, instead of the thread or yarn being wound upon a small bobbin or roller, situated upon an horizontal axis in the ordinary manner. Another of the improvements which I claim as new in these shuttles, consists of the regulating spring, marked D D, in the figures, as operated upon, or regulated in its force by the adjusting screw, marked *e*, for the purpose of adjusting or regulating the tension of the yarn in passing off the circumference of the bobbins. At the same time I wish it to be understood, that I do not claim the general use of springs, as applied in shuttles for weaving, but only for the particular manner of applying them, and providing them with a regulating or adjusting screw, hereinbefore described and set forth.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

By this invention all sorts of woollen goods can be made in the most complete manner, uniting both beauty and strength, and without any difference of quality to be found through all the piece, of whatsoever it be manufactured; which cannot be asserted of any of those made in the usual way, since the stretching of the wool has always caused in them irregularity and defects, very offensive to the eye, such as clear places, shrinkings, &c.

We cannot be astonished at the impossibility hitherto found of manufacturing any thing in a perfect manner, since the warp is either stretched, or the shoot irregular. This is so true, that when the manufacturers desire to have any thing woven carefully, they have it done by the hand shuttle, which obliges the workmen to spend a great deal of time in completing their work, because they are obliged frequently to straighten the threads of the shoot; and it often happening that they are not arranged like the first,

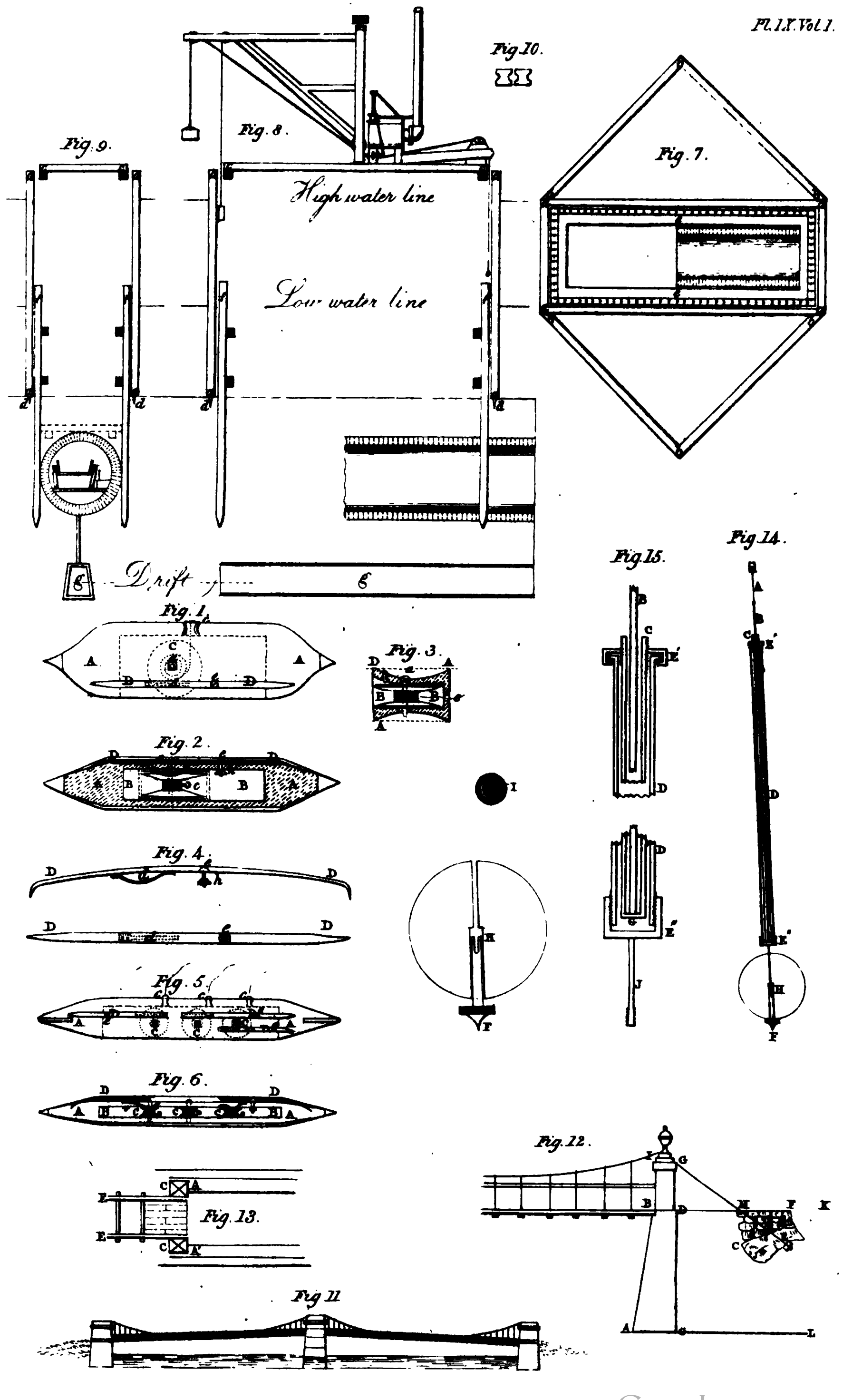


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.
High water line
Low water line
Drift

they are obliged to rectify it, and, notwithstanding all their precautions, the work can never be perfect, on account of the stretching not being always alike.

The necessity has long been felt of regulating the stretching of the shoot, in order to produce perfect woven goods. To effect this, the manufacturers have contrived a piece of bent wire, to form a small spring, upon which they pass the little bobbin, *which runs from left to right, the weight of which, when its load is diminished, causes a change in the stretching of the shoot, and consequently the effects of it are visible.* On the other hand, every time the bobbin is changed, it happens that the hole of the new one is larger or smaller than that of the preceding one; then the piece of bent wire does not cause the same resistance, and the workman finds himself obliged to open or to shut this wire, to prevent the bobbin from turning, and emptying itself too quickly or not enough.

These defects have been so fully acknowledged, that many manufacturers have employed all their means to rectify them. They at first substituted another piece of wire, consisting of three branches, in the form of which I have just spoken, and the result was not more fortunate; the reason, as I have just shown, is quite simple. They afterwards followed another method, that of putting in hairs, tied together, so that they might form a kind of little spring to the shuttle, which, forming a kind of brush, deteriorated the goods; for it chafed the thread, and thereby injured its quality and lustre, and so weakened it, that it frequently broke, which obliged the weaver to lose much time in joining the broken threads.

My invention affords a complete remedy for all these defects, and by means of it the work is brought to the greatest degree of regularity.

In order to justify what I have advanced, and to give proof of my experiments, I attempted to make with the fly-shuttle wire gauze, which is more difficult to weave than any thing else, and I have the satisfaction to say I succeeded most completely, and can weave wire gauze

with a perfection hitherto unprecedented, and with the same facility with which other goods are woven. The advantages to be derived from my shuttle will appear from the subjoined account of its application in the manufacture of the principal branches of weaving, as follows:

1. *Silk Goods* may be woven of a regular texture, with a most beautiful lustre, and superior both in quality and durability to those manufactured in the usual way, possessing none of those defects which the old method occasions, and which the most skilful hands cannot rectify. There will also be a great advantage from using this invention, in making figured silks in the ordinary method. When it is necessary to use silks of various colours, so many different shuttles must be used as there are colours; but on my principle one shuttle only is necessary, and the work will be most complete; much time will be saved, and more work done, than if the workman were obliged every moment to change his shuttle. I shall also add to these advantages, that of my shuttles containing *ten times* more silk, cotton, &c. than those usually employed.

I must not omit to mention an article of great value, which can also be manufactured with my shuttle in the most beautiful manner, which article I call *Camelion,* from its continual change of colour as it is moved about, and which is superior in brilliancy to any other article hitherto made of silk, possessing great richness and softness, and from its novelty and beauty likely to become very much in demand.

2 and 3. *Cotton and Hemp Weaving,* performed by my new fly-shuttle, appears neater, is more regularly done, quicker weaved, and free from shrinkings, &c.

4. *Flax Goods,* which are manufactured but very rarely with the fly-shuttle, might always be so if those on my principle be adopted, and of any required width, with as regular a texture as the articles abovementioned.

5. *Woollen Cloths.*—All sorts of woollen cloths can be manufactured with the same perfection as the preceding.

6. *Metallic Gauzes.*—These gauzes, which have always

been woven with much trouble, and very slowly, can be made with shuttles on my principle with the same ease as the preceding articles, in the most perfect manner, and twice quicker than what is usual. To give an idea of the great benefits arising from all these advantages, I can venture to assert that the work which is generally done in a week by 300 workmen, can, by my method, be done in that time by 100; which, calculating each workman at 2*l.* per week, will save in wages weekly 400*l.*

There will be also a considerable saving in manual labour, namely, for gauzes of five feet in width, in making which two workmen are obliged to be employed at each loom; by my method the same width can be made by one workman; therefore, with 200 looms, which now require 400 workmen, by my principle only 200 will be required.

The metallic gauzes, of which I have just spoken, are sold now at four shillings the square foot: they can, on my principle, be manufactured at ten-pence!!

A Plan for proceeding with the Tunnel under the river Thames, from Redriffe to Limehouse, taking the present state of things (1809) *as a basis.*

By R. Trevethick, Engineer.

Abstracted from the Papers and Documents of the "Thames Archway Company."

A shaft being already sunk on the Redriffe side, 76 feet below the level of high water, in which are two pumps, worked by steam-engines, capable of lifting 1500 gallons of water per minute; and a drift made from the shaft on the South, to within about 70 feet of low water mark on the North shore, at the depth of 72 feet below high water, the springs of which drift furnish about 400 gallons of water per minute.

It is proposed to excavate a sufficient space in the bed of the river to admit the building of a portion of the tunnel, either of brick or cast iron, the crown of which shall be at a small distance, say 6 or 8 feet, below the bottom of the river.

This excavation to be made, and the tunnel formed, within a set of piles, driven inside a moveable cassoon or coffer dam, of the following construction, and of such a length as the conservators of the river may allow: 40 feet deep, 50 feet long, and 4 or 5 feet wider than the exterior diameter of the tunnel, will be sufficient for the inside dimensions.

In the accompanying drawings, which are calculated for a cast iron tunnel, of 12 feet diameter, $1\frac{1}{8}$ inch thick, in pieces 6 feet long, inserted one into the other the distance of 6 inches, and caulked.

Fig. 7 represents a plan; fig. 8 a longitudinal, and fig. 9 a transverse section of the cassoon, tunnel, drift, &c.; fig. 10, transverse section of piles.

a, The cassoon, 50 feet long, 18 wide, and 40 deep, made of 12 inch square balk, fastened together with trunnions, and made water tight by being caulked.

b, Screens or fences to break the force of the current, and protect the cassoon from vessels, &c. made of old ship timber, about 36 feet long, attached to the corners of the cassoon, and meeting in a point. These screens or cutwaters are to be the same depth as the cassoon.

c, A platform over the cassoon, on which a crane and a steam-engine, of 4 or 5 horse power, are placed to work a pile-driving and drawing apparatus, and raise the excavated earth to deliver it into barges.

d, Iron spears at the bottom of the cassoon.

g, The drift.

Thus much being prepared, two triangular barges or boxes are to be made to fit the spaces between the cutwaters and sides of the cassoon. These barges or boxes being fixed in their places, are to be loaded with so much ballast as would enable the whole cassoon to be sunk by the admission of water into them. It is then, at high water, to be floated altogether to the deepest part of the river over the drift, with the cutwaters pointing up and down the stream; and when in this situation, a plug is to be taken out of each triangular barge, so that they may

be filled with water, and cause the whole to sink, forcing the spears into the bottom of the river, which must have been previously made even by means of ballast barges.

Guiding frames, *e*, 48 feet long, and 16 wide, are then to be suspended or fastened by moveable bolts within the cassoon, and piles, *f*, 40 feet long, and 12 inches square, driven down between the cassoon and guiding frames, till their points are at least two feet lower than the bottom of the intended excavation. The piles must be capped and pointed with iron, and have a semicylindrical groove of 4 inches diameter, extending from one end to the other. Each pile is to be driven with this groove next to the flat side of the adjoining one. After they are all driven, oakum, &c. being well rammed down this groove, will effectually keep out the water. The space also between the tops of the piles and the cassoon, must be caulked at low water, when the tops of the piles will be out of water.

This being done, a hole is to be bored down into the drift, or from the drift up to the inside of the cassoon, and a pipe put in to let the water down into the drift.

Should any thing obstruct the driving of some of the piles, or should they take a wrong direction, they must be left until the rest are driven and caulked, when, the water being drained out, excavations may be made to the bottom of those piles, and the obstruction removed, after which they may be driven to their proper places.

The greatest depth of the river at high water being 38½ feet, and at low water about 17, the cassoon will be 18 inches above the water at high water, and the tops of the piles 3 feet above at low water; the latter time of course must be taken for the caulking.

Two or three thicknesses of strong well tarred canvass, nailed all round on the outside of the bottom of the cassoon, and spread out on the bed of the river, would take off much of the pressure from the lower ends of the piles, and obstruct the entrance of water under the cassoon.

It is not expected that there will be any necessity for

mooring the cassoon, since the weights in the triangular barges may easily be 150 tons more than is sufficient to sink it. This would greatly overbalance the force of the current, which at two miles per hour acts only with five pounds on the square foot, or 5 tons against the whole cassoon. It may not, however, be an improper precaution to protect it from shipping, by mooring an old vessel up and down the stream.

As the water is drained out, beams must be put across inside the cassoon, in order that the pressure on the outside may not force in the sides. When the water is out, an excavation is to be made at one end, the whole width of the cassoon, 18 feet deep, and 6 or 7 long. Beams are also to be put across as the digging proceeds.

When this excavation is completed, a 6 foot length of the cylinder, supposing cast iron to be adopted, is to be put in, the beams being taken from below, and put above the cylinder, as it passes down. Then another 6 feet is to be excavated, and a second length of cylinder inserted 6 inches into the first, and caulked from the inside, when it may be filled with earth, to be taken out again after the whole tunnel is finished. This will prevent its being filled with water, which would have to be drawn out every time the cassoon should be removed. A third length is then to be added to the second, and so on till so much is completed as can be made within the cassoon. The first two or three lengths should be filled with clay, well rammed, to prevent water from the river passing in when the end piles are drawn. The space above the tunnel must be filled with the excavated earth, and puddled to the level of the bottom of the river.

In order to prepare for removing the cassoon forward another length, a set of piles in a frame must be fitted close, and fixed over that end of the tunnel proposed to be continued, and the earth, or rather some clay, well puddled to the frame, so as to prevent any water coming between it and the top of the tunnel to the next length.

The pipe which conveys the water to the drift is then to be stopped, and all the piles drawn except those last fixed. As the piles are drawn, the holes which they leave should be filled up.

When every thing is ready for the removal, and the water low enough to be out of the triangular barges, the plugs must be put in, which will make the whole apparatus float when it is nearly high water, at which time it can easily be moved forward, till the opposite end arrives against the piles that were left. The plugs are then again to be taken out, which will cause it to sink as before.

The same operations as above described must be again performed, and the work repeated, till the tunnel is finished to the shore. After which, the cassoon is to be again fixed in the deep water at the part first began, from whence it is to be continued to the other shore.

A cast iron tunnel of the above size, together with the pavement and superincumbent earth, will about equal the specific gravity of water, but not quite; consequently, if it did not adhere to the earth, it would have a tendency to rise; but taking the adhesion into view, no doubt can be entertained but that it will remain perfectly secure in its bed.

The very small quantity of water that ever can come into this tunnel when finished, might be thrown out by a horizontal forcing pump at the lowest part, worked by a rod, passing along under the pavement to a small steam-engine or horse power on the outside, near the entrance. This would do away the necessity of continuing the use of the drift and large steam-engine.

From borings and other proofs, it is certain that the stratum in which the tunnel would lay at the North side of the river is strong clay, which would occasion no difficulty.

If, as there is every reason to believe, the gravel stratum of 27 feet thick, which was sunk through in the shaft, dwindles to the North into two quicksands, one of 3 feet

thick, with 3 feet of strong clay between it; and another quicksand of 4 feet in thickness, under which the declination is one in fifty to the North, there will be gravel or quicksand, or both, towards the South, within the 18 feet which it is proposed to excavate. That this change from gravel to quicksand does take place seems probable, from the circumstance of the quicksands which were met with in the drift being fed with water from the South, and also from their being found where the thick stratum of gravel was expected by calculating the decline from the shaft, as well as by there being no water in any of the strata below the gravel that could feed them; but by borings in the river, and from the different breaks through the roof of the drift up to the bottom of the river, nothing being found but clay from the North shore for about 300 feet southward, it is rendered certain that the gravel stratum does not extend so far North.

It is therefore likely, that as the quicksands rise towards the South, and before they are high enough to interfere with the tunnel, they change to gravel; but should that not be the case, and the quicksand be met with in the excavation, the piles may be driven down through it into the strong clay, which will exclude the sand at the sides.

But should the water in the quicksand be inclined to blow up, the bottom holes may be bored from the drift up to the sand, by which the water will be drained off, and remaining dry, no such effect can then take place.

Admitting, however, that the bottom of the excavation were blown up, no mischief would be done, and very little delay occasioned, because the points of the piles being in firm clay, would prevent their giving way.

Should there be much water in the gravel on the South side of the river, a great deal of it may be drawn off by boring on the side of the shaft.

If a brick tunnel be preferred to an iron one, it will require no variation in the excavation but that of making it something deeper and wider.

Description, measurement and estimate of a Bridge of Iron-wire, constructed over the river Galore, at St. Vallier, in the Department of Isere. By M. Sequin, Sen.

In commencing the translation of this interesting little publication, to save repetitions we think it may be desirable to state, that the *metre*, in multiples and parts of which the measurement of this bridge is given, is equal to 3·281 feet English; that the *kilogram* is nearly two of our pounds; and that the frank, at the medium course of exchange, of 25 franks to the pound, British, is worth 9·6 pence of our money. St. Vallier, where the bridge was constructed, is situated near the Rhone, about 40 miles below the city of Lyons.

I.

This bridge was constructed to determine by actual practice, if some dispositions, which theory indicated, would exactly correspond with the design proposed, and to serve as an experiment and guide for the erection of a bridge on a larger scale at Tournon, about two leagues distant from its scite, and was intended for the passage of horsemen, foot passengers, and beasts of burden. It is situated near a pleasant garden, that belonged to the late M. de Saint Vallier.

The floor (or roadway of the bridge) is raised five metres above the level of the water. Its total length, from the middle of one of the supporting columns to that of the other, is 30 metres, and its breadth is $1{\cdot}65^{m}$.

Strong parapets give it such a rigidity, that fifteen or twenty persons walking over it together occasion scarcely any sensible vibration. To prove it, I have walked over it, accompanied by three of my brothers, stepping altogether, without causing any vibration; and I have since learned, that many persons had passed over it on horseback, although the bridge was traversed at the same time by three other horsemen with their horses, but who, being

more cautious, had alighted and led their horses over. I have been also assured that a horseman was seen passing over at full gallop, without the bridge vibrating in any perceptible manner.

This floor is suspended from four iron cables, of about two centimetres in diameter, by means of vertical cords of wire. The wire cables, after having passed over square columns of 2·20^{m} high, are hooked to rods of iron, which are themselves fastened to pieces of oak, loaded with part of the mass of the abutments. It was constructed at the expence of some persons interested in procuring a passage over the river, in the place of an ancient ruined bridge, of whose foundation there were still some parts remaining, sufficiently solid for the support of the abutments.

Its length was at first intended to be 25 metres, and its height 4^{m} above the lowest level of the water. The abutments, A B C D, (fig. 12, Pl. 9) of 1·50^{m} in thickness at the base, A C, and 1^{m} at the crown, B D, accompanied with the side walls, D C L K, of one metre at the base, and 0·50^{m} at the upper part, seemed to me sufficient to resist the draught of the cables, and to serve as a base for the columns of free-stone, B D G H, of 2·20^{m} high by 0·65 square, intended to support them. Such were the original designs, which had been already partly executed, when local considerations induced those interested in the work to increase the length of the bridge, at first to 28, and afterwards to 30 metres, and to build the abutments to the height of 5 instead of 4 metres.

The limits of expence to which we were confined, obliged us to use the materials, such as they were, which were intended for the piers, and to continue of the same dimensions the work of the abutments; on which account these different parts were weaker than the calculation demanded. However, as it was of use to determine by a decisive experiment, what confidence we ought to place in the calculations of the resistance of the masonry, and of the masses of the work, we did not hesitate to put it to proof, and it was agreed that we should undertake to furnish, transport, and erect,

at our own risk, the whole of the system of suspension and flooring for 1800 francs, which, joined to 1500 francs for the masonry, and from 6 to 700 francs employed on the approaches, and other accessory objects, would form altogether a sum of 4000 francs, to which the whole expence of the bridge would actually amount. Fig. 11, represents the view of the whole, and figs. 12 and 13 the parts. The abutment of the right bank is built on the remains of the old foundation. Its height, A B, fig. 12, is 5 metres above the level of the Rhone, from which it is about 200 metres distant, and its breadth, A A, at the level of the floor, is 3·20^m; its depth at A C is 1·50^m, and at B D 1^m. The side walls, D C L K, on a level foundation, are 1^m thick at the base, and 0·50^m at the top. The columns are all alike; they rest on the angles which the piers make with the sidewalls, and have, as before-mentioned, a height of 2·20^m, by 0·25^m square, having on their tops plinths of 0·25^m high, with a projection of 0·02^m.

Above the columns are placed blocks of oak, rounded at the top, 0·40^m broad, by 0·20^m thick, to be surmounted by vases of cast iron, which are designed to be placed there for ornament. These blocks are fastened to the stone by two bolts of iron, 0·30^m broad, by 0·15^m thick, countersunk in the place which the cables were to occupy, in a groove of 0·02^m depth. The four iron cables which sustain the bridge enter into those grooves; they are formed by the union of 30 iron wires, of No. 18, fastened to two half rings, or cushions of cast iron, 0·01^m thick in the middle, and sustained by rods of iron of 0·02^m diameter, which passing through the bars of the half rings of iron, are doubled together and fastened behind pieces of oak, 0·30^m square, built up in the masonry of the side walls, and loaded with two or three large blocks of hard stone, of about 0·50^m cube, over which the walls are raised to the level of the floor, in a manner that admits of repairing or replacing the iron moorings, when thought necessary, in taking up the causeway behind them, without removing any part of the mass of masonry.

This mass, at the right bank of the river, is about 2^m high; but that on the left is only raised $1{\cdot}40^m$, on account of the elbow of the side walls not permitting it to be extended more than 4^m from the piers; nor the weakness of these latter to fasten down the cables in an angle of more than 45 degrees.

The floor is suspended from the cables by 58 vertical cords, each of 4 wires. They are bound on the upper part by some turns of fine wire, softened in the fire, and pass beneath the cross rafters. These cords are formed by a single piece of wire, forming 4 doubles, of which the ends are bound together by wire of No. 1, for the space of about $0{\cdot}06^m$. Their length was determined by suspending to a wire, of the same length as the bridge, 29 weights of $0{\cdot}5^k$ each, and stretching the wire until it formed in the middle a versed sine of $2{\cdot}20^m$, equal to the height of the piers. These vertical cords were fastened to the cables in our workshop, and the whole was thus carried altogether and put up in its place, without requiring any great precautions. The cross rafters were then passed through the loops of the vertical cords, and were covered with planks to serve as a scaffold, as soon as they were put in their places; but it was soon perceived that the moorings gave way a little, before all the weight was laid on. This effect, joined to a small lengthening of the iron rods, and to the penetration of the screws into the wood, caused the columns to be drawn forward two or three centimetres. This was immediately remedied by increasing the weight with which they were charged, and by bringing them back, by means of the screws of the moorings, to the vertical position, from which they did not depart any more afterwards.

The cross rafters, 29 in number, are placed 1^m asunder; their length is 2^m, their depth $0{\cdot}14^m$, and their thickness $0{\cdot}08^m$: they are attached alternately to each of the cables. The floor is placed directly upon them. It is composed of six rows of planks, $0{\cdot}26^m$ broad, and $0{\cdot}054^m$ thick, with intervals between them of 0.01^m, to let water pass through.

The parapet was put up as soon as the cross rafters were fixed in their places. It is composed of two rows of rails, of 0·11^{m} depth, and 0·075^{m} broad, scarfed together, and each kept a metre asunder from the other, by crosses of St. Andrew, of 0·06^{m} in thickness. Between each of the joints of this framing are put bolts of 0·015^{m} diameter, which, connecting the rails and the cross rafters, give the whole such solidity, that it is impossible, whatever effort several persons can make together in walking or in leaping on it, to give it any vertical movement; but in the horizontal direction its rigidity is less, and a single person, by spreading out his legs so that his feet may approach each of the parapets, may, by balancing himself slowly from side to side, cause a very perceptible movement, and which would soon become disagreeable, and has much resemblance to that which occurs aboard a ship.

This bridge being designed particularly for foot passengers, and for the occasional use only of horses, it was agreed that it should be tried by a weight of 5000^{k}, which, joined to its own weight, ought to occasion a draught on the cables and the abutments of about 17,000^{k}. This was no considerable stress for the cables and moorings to bear, but it was almost the extreme limits of the resistance of the left abutment; which, being composed of the parallelopiped, M C E F, of about 5 cubic metres, of 2800^{k} each, only formed a weight of 14,000^{k}, which was inferior to that which we required; but the resistance of the moorings might be supposed divided into the horizontal and the vertical, and that it would be sufficient to counterbalance this latter by a weight of 12,000^{k}.

Such are the circumstances in which this trial was made. The bridge was first loaded with gravel, along with gabions and hand-barrows, until the whole amounted to about 4500^{k}. Some of those who were interested in the bridge, and who were present, then required that the experiment should be pushed no farther, from apprehension that some parts of the parapet might be injured, and from being certain that the bridge would never be exposed to a weight

by many degrees so considerable. But the principal proprietor being absent, and I being besides convinced, as well as my brothers who were present, that there was no danger in completing the trial, we did not hesitate to go on it ourselves, inviting at the same time some persons who were there, to do so likewise, persuaded that some cracks in the walls, or some movements in the masses of masonry, would give us warning sufficiently in time to retire, if there was any danger. The proof then had the following amount:

Gravel	4500
The weight of fifteen persons	900
	5400^k

and men were employed in clearing the bridge, when the proprietor who had been absent arrived. In consequence of an observation which he made, "that the bridge being intended for the service of passengers, he desired to know if it would bear, in a satisfactory manner, 40 persons, walking all at once over the floor," we caused about half the gravel which was heaped on it to be removed, and undertook to go on it with 40 persons, to commence a fresh proof, which we knew was under the amount of that preceding. But the number of curious people who crowded on was such, and their eagerness so great, that it was impossible to stop them in time, and their amount was computed at 70 or 80 persons who were on it together. The whole of the weight then at that time was,—

Gravel	2500
Seventy persons, at 60^k	4200
	6700

This severe proof did not produce the least crack in the walls, nor any movement in the mass of masonry, which seemed to indicate, that with cables and moorings thus disposed, the effect which the calculation announces may be almost entirely depended on.

II.

CALCULATION OF THE STRAINS AND RESISTANCES.

Weight of the materials with which the cables are to be loaded.

IRON AND IRON-WIRE.

Four cables of thirty wires, each 32^{m} long	3840^{m}		
Fifty-eight vertical cords of 4 wires, of a medium length of 1^{m}	282		
Four lower moorings, to keep down the floor, of six wires each, of $8{\cdot}50^{m}$ long	204		
Fastenings of the cables and cords, estimated	224		
	4500		
Weight of a metre of wire	$0{\cdot}058^{k}$		$261^{\cdot k}$
Fifty-eight bolts of $1{\cdot}30^{m}$ long, and $0{\cdot}015^{m}$ thick, at $1{\cdot}70^{k}$			98·60
Twenty-four bolts to strengthen the parapets, of $0{\cdot}02^{k}$			4·80
Nails for the floor			16·60
			$381^{\cdot k}$

OAK TIMBER.

Twenty-nine cross rafters, of about 2^{m} long	58^{m}		
Squaring, $0{\cdot}14^{m}$, by $0{\cdot}08^{m}$	0·0112	$0{\cdot}65^{m}$	
Total length of the rails of the parapet	120		
Squaring, $0{\cdot}11^{m}$, by $0{\cdot}75^{m}$	0·00825	0·99	
One hundred and twenty pieces, of $1{\cdot}40^{m}$ long, forming St. Andrew's crosses	168		
Squaring	0·0036	0·60	
Length of the floor, 30^{m}; Breadth 1·66	4·98		
Thickness	0·054	2·68	
		4·92	
Weight of a cubic metre of oak		$930^{\cdot k}$	4575·60
Varnish and moisture			43·40
Proof agreed on			5000·
			10000·

This quantity, multiplied by 30^{m}, the length of the bridge, and divided by $17{\cdot}60^{m}$, or eight times the versed sine, which we have already stated to be $2{\cdot}20^{m}$, gives us 17·000.—(*Vide des Ponts en Fil de Fer par Seguin aine. Paris*, 1824.)

But the loading in the proof having been really 6700, it follows that this strain was $11{,}700^{k}$, which, multiplied by $\frac{300}{176}$ = 20,000 nearly. The four cables are composed of thirty wires each, which, at 500^{k} to a wire, would altogether sustain $60{,}000^{k}$. They had been tried in our workshop, each by a weight of 5000^{k}. The bars of the mooring, of $0{\cdot}02^{m}$ diameter, eight in number, presented together a section of 2512 square millimetres, at 30^{k}, = $75{,}360^{k}$, and had been proved by 2500^{k} each. There now remain the abutments. That of the right bank had evidently an excess of resistance; but the mass of masonry of the left side having but $3{\cdot}2^{m}$ in length, $1{\cdot}40^{m}$ in height, and $1{\cdot}10^{m}$ in thickness, contained altogether but 5 cubic metres in its solid contents, each at 2800^{k} = $14{,}000^{k}$. Supposing then that the strain of the draught, which $17{,}000^{k}$ produced on the cables, divided in the directions E F, E C, (fig. 12,) and that the mass of masonry was only required to counterbalance one of the component directions, E F, equal to $\sqrt{\frac{(17)^2}{2}}$ or about $12{,}000^{k}$, and we have just seen that thereal weight was $14{,}000^{k}$; there remains then in all strictness an excess of 2000^{k}, with the addition of the cohesion of the side-walls. There was not, besides, any probability that the mass of masonry would slide forward, considering its distance from the abutment. But it was doubtful that matters would happen exactly thus, and whether some parts of the walls, or of the masses of masonry, which, still fresh, could have acquired but little cohesion, would not have separated from the mass. Experience, however, proved that every thing succeeded according to the calculations.

It might be feared, considering the weakness of the

columns, that the strain, resulting from the difference of the angles of the cables and of the abutments, might be sufficient to upset them. In effect, the draft of 17,000^k, divided according to the vertical and horizontal directions, caused a horizontal strain from inwards, of

$$\frac{17000^k \times \sqrt{(30)^2 - (8 \cdot 8)^2}}{30} = 16{,}200^k$$

And as the resistance from within outwards only amounted to

$$\frac{17000^k \times \sqrt{\frac{(2)^2}{2}}}{2} = 12{,}000^k$$

The difference, 4200^k, indicated the strain that would take place to overthrow the columns, if cables had been allowed to slip freely over their summits. The resistance of the two at each side, being compounded of their mass, multiplied by half their thickness, and divided by their height, would be equal to

$$\frac{2 \cdot 2 \times (0 \cdot 65)^2 \times 2 \times 0 \cdot 325 \times 2800}{2 \cdot 20} = 760^k,$$

a quantity very inferior to the above. But from the experiments of M. Coulomb, we may calculate that a force, employed in making a body slide over a horizontal plane, is nearly the half of that which would be required to raise it. We may then conclude, without any apprehension, that the friction would be equivalent to 4200 — 760 = 3440; since the resistance ought to be nearly 8700^k, fairly estimated.

As we had principally in view, in adopting this species of construction, to determine the degree of rigidity which the parapet could give to the floor, I have compared, by means of the formulæ given by Navier, the increase of versed sine which ought to be produced by the weight of a horse, which I estimate at 500^k, on a bridge perfectly flexible, with that which it really experienced. This increase will be expressed in denoting by

μ. The weight of a horse.......................... 500^k

f. The versed sine .... 2·20^m

P. The weight corresponding to the unity of the length of the floor, $\frac{5000}{30}$ . . . . 160[k]

h. Half the length of the bridge . . . . 15[m]

$$f^1 - f = \frac{11f}{4Ph}$$

(*Vide Memoire sur les Ponts suspendus par M. Navier, fol.* 80.) or putting, in place of the letters, the values relative to the particular case which we are examining.

$$f^1 - f = \frac{500 \times 2{\cdot}20}{4 \times 166 \times 15} = 0{\cdot}11^{m}$$

The degree to which the curve of suspension should be lowered, or the versed sine increased, should be eleven centimetres, while in the bridge itself it is not appreciable.

III.

MEASUREMENT AND ESTIMATE.

Digging for the foundation . . . . 18[f]

Beton (a mixture of cement and small stones or gravel) . . . . 8[m]

MASONRY.

Length of the abutment at the base		4·20[m]			
——— at the top		3·20			
		7·40			
Medium length		3·70	4·625[m]	23·125[m]	
Thickness at the base	1·50[m]				
——— at the top	1·				
	2·50				
Medium thickness	1·25	1·25			
Height			5·		
The same for the other side				23·125	
				54·250	
Length of 4 side walls	58·	43·50		108·750	
Medium thickness	0·75				
Medium height		2·50			
Mass of the moorings				7·	
				170·[m]	1275
Price of a cubic metre of masonry				7·50[f]	
Cut stone for the columns and the angles					200
					1493

IRON-WORK.

Four cables of iron-wire, the particulars of which have been before given, at 2 fr. the kilogram, (the price at which our house delivers them varnished, proved, and ready to put up)........................		261·k	522·f
Other forged iron employed in the suspension		120·	
Thirty-eight cramp-irons for the parapets, the blocks, the moorings, and the ends of the floor, &c..........................		25·80	
Sixteen rods of iron, of 0·02 diameter, for the two abutments........................	108·m	265·20	
Area or section of a rod of 0·02 diameter	0·00314		
Weight of a cubic metre of iron............		7800·	
		411·00	493·20
Price of a kilogram of wrought iron.........	1·20f		
4·93m cube of oak, for the parapet and the floor, at 60f.............			295·20
Workmanship			150·
Carriage from D'Annonay to St. Vallier........................			60·
Painting			55·
Setting up			250·
			Fo. 1825·40

Such are the results of this experiment, which completely satisfied us with regard to the analogous dispositions which we adopted at the bridge of Tournon.

This great erection was commenced on the 12th of May, 1824. The river being constantly high during the summer, forced us to lay all our foundations about a metre below the level of the water, by the assistance of a diving bell, of a very simple construction, of our invention, of which I intend to publish a description which I hope will not be without interest in the arts. We had scarcely began to run our (*betons*) cements, when an extraordinary rise in the river carried off our temporary bridges, and a part of our inclosures and of our *beton*. But some weeks favourable to our labours have been sufficient to repair all, and to give us to hope, that in the course of July 1825, the bridge will be ready for the public.

It is composed of two equal traverses, each of 85m. The breadth of the floor is 4·50m, with an enlargement in the middle corresponding to the pier, and on which three car-

riages can be ranged. It will be sustained by twelve iron cables, each of a hundred wires of No. 18, of three millimetres in diameter, forming a versed sine of eight metres, equal to the height of the abutments above the floor.

Reply of Mr. Herapath *to the Observations of* "W." *on his Compensation Pendulum.* Communicated by the Author.

Bristol, 56, *Old Market-street, August* 3, 1825.

Gentlemen,

I have read in your second Number an anonymous correspondent's strange remarks upon my description of a compensation pendulum, inserted in Philosophical Mag. No. 325. That description was certainly very short, and the accompanying wood-cut rough; but I did not conceive it possible that I should be so misunderstood. W. makes me say, "the wire connecting the ball with the bottom of the iron tube should be added after the pendulum is made as usual in common clocks." I can assure him such an idea never entered my head; if it had I should have considered the adoption of it quite as strange as he does; for the expansion of the additional wire would not only, as he says, have been uncorrected, but the pendulum would have been too long by many inches to beat seconds. The "usual," in my description, only applied to attaching three inches of steel spring to an iron wire. I did not expect that any reader would require to be told to cut the wire so much shorter as he intended to add in length below, any more than I should think it necessary to tell a man, capable of reading, that B follows A in the common alphabet. This misconception of W.'s is the more unaccountable, as I have given the total length of the pendulum as

$$\begin{array}{ll} \left\{\begin{array}{l} 3\cdot \\ 36\cdot139290 \end{array}\right. & \begin{array}{l} \text{inches of steel spring} \\ \text{of iron} \end{array} \\ \;\;27\cdot92 & \text{of iron} \\ \hline \;\;67\cdot059290 & \text{inches.} \end{array}$$

Now as 27·92 of this

must be deducted as duplicature, how could W. find 47 inches left? So much for my material error!

Rough as the wood-cut is, W. will find, upon re-inspection, that the pendulum ball possesses a shoulder in the centre, which rests on the upper end of the screw. Therefore, the ball is supported by the centre, and requires no correction for its expansion, as it takes place equally in every direction.

Having thus shown to whom the "material errors" belong, I shall examine his objection to a tubular pendulum, in order to weigh the difference between the latter and a perfect instrument. The compound rod, when finished, may be but little more than $\frac{1}{4}$ of an inch in diameter; but I will suppose it constructed by a clumsy workman, who could not succeed in making it less than $\frac{1}{8}$ an inch in diameter. A sudden change of 30° in temperature would pass through such a rod in less than $\frac{1}{4}$ of an hour. Now 30° F. operating upon a common pendulum rod for 24 hours, would alter the rate of a clock about 8″ in that time; and consequently, for $\frac{1}{4}$ of an hour, $\frac{1}{96}$ of 8″, or $\frac{1}{12}$ of a second; but as the zinc tube would receive 15° F. while the external iron tube and wire were receiving 30°, the alteration of rate must be less than $\frac{1}{2}$ of $\frac{1}{12}$ of a second.

As I find it is necessary to be extremely explicit, it may be well to inform such as may attempt to make one of those instruments, that as the rod has more weight than a silk string, the *centre of oscillation* will be farther than 39·13929 from the point of suspension, and consequently the zinc tube must in practice be a small portion longer than 27·92. As this small portion cannot well be calculated, my pendulum will, like all others, require an adjustment after being affixed to the clock.

As W.'s remarks may confuse your readers' notions of the instrument, I shall feel obliged by your inserting the following short description of the inclosed drawing.

A. Fig. 14, Pl. IX. The watch spring, 3 in. long.

D. Figs. 14 and 15. Iron wire, fastened to the watch spring, about 32 in. long, having the brass foot, G, hard-soldered to its lower end.

C. The zinc tube, about $28\frac{1}{4}$ in. long, having a screw cut on its top.

E. The external iron tube, which, with its screw collar, E′, is about 27·6 in. long.

E′. The screw collar, supporting the external iron tube by a shoulder. The elevation of this collar lengthens in effect the zinc tube.

E″. Another screw collar, by holding which steady while the upper one is turned, the length of the zinc tube is altered without altering the total length of the pendulum rod; it is connected with the wire, J, of sufficient length to measure about 40 in. from the knife edge.

F. The screw for regulating the pendulum to time, without affecting the compensation part; it has a point on its head to act as an index for measuring the arc of vibration.

H. The shoulder in the *centre of the pendulum* ball, by which it is supported upon the end of the screw, F.

I. Section across the pendulum rod.

In taking my leave of W. I beg to thank him for his kindness in attempting to correct what he thought my mistakes; and as he seems fond of the amusement, I must direct his attention to the following quotation from his remarks, p. 107:—"The wire, having a *great surface in proportion to its solid contents*, will *more rapidly* come to the temperature of the air on a rise of the thermometer, *than* the tubes!!"

I am, Gentlemen,

Your most obedient Servant,

WILLIAM HERAPATH.

Mr. Herapath's expression in the beginning of his letter, "W. *makes* me say," conveys an accusation entirely undeserved. We have carefully perused both Mr. H.'s

original paper, and W.'s remarks, and it appears that in the quotation which W. has made from Mr. H.'s description, commencing at the word "Having," (line 12 from the bottom of page 105) and ending at "pendulum ball," there is no material word added, nor ought diminished.

As to its being "as plain as that B follows A," that three inches were to be cut off the wire, when the spring of that length was directed to be added to it, we differ again in opinion with Mr. H. If readers were to make additions and alterations to that extent, and impute them to writers, the latter would have still less reason to be satisfied, than where they are interpreted as their expressions denote. At all events, Mr. H. after blaming W. for "making him say," as above noticed, should not blame him again for *not making him say* what is not expressed in his paper.

We very willingly insert Mr. Herapath's amended account of his pendulum, but think that instead of our correspondent W.'s remarks confusing our readers, as Mr. H. asserts, they have, in fact, been the means of making the account of the pendulum ultimately understood, which must otherwise have remained problematical.

The wood cut of which Mr. H. complains, is certainly not very good, but it is plain enough to be understood; and without it, most of the apparatus of the pendulum must have remained unintelligible, as it is no where else explained in Mr. H.'s paper. We have examined this cut, and observe a part in the tubular perforation of the bob larger than the rest, which we suppose Mr. H. intended for "the shoulder" which he mentions; but we should also observe, that the nut, on which the bob rests, is very plainly represented at the bottom of the bob, screwed on the wire, and that therefore W. should not be censured for supposing, that it was not intended to place this nut at the shoulder, in the middle of the bob, without which, or some method of conveying the action of the nut to the said *shoulder*, the latter is evidently of no use whatsoever.

We must also beg leave to terminate Mr. H.'s imagined

triumph, relative to the wire and the tubes, by the following proof, that wire of a certain proportion to the thickness of the side of the tube, will have a larger surface.

Suppose the side of the tube to be a sixteenth of an inch thick, and that the wire is a sixteenth of an inch in diameter. To compare the two we must divide the surface of the tube into as many portions, equal in size to the wire, each less of course than a sixteenth of an inch in breadth, as can be contained in its periphery. Each of these, then, will have but two sides exposed to the air, while the other two are hidden in the solid substance of the tube; and the wire having the *whole* of its surface exposed, which will be evidently much greater than the exposed parts of the above divisions of the tube, while its solid contents are the same from the hypothesis, will of course more quickly acquire the temperature of the atmosphere.

Observations on the Cutting of Screws. By A WORKMAN. Communicated by the Author.

HAVING had considerable experience in the construction of new and complicated machinery, and knowing of no method by which minute and accurate movements or divisions may be obtained with such certainty as by means of the screw, it has not unfrequently been the most trying part of my labours to obtain a screw that shall be tolerably accurate throughout, when it has been required of any considerable length. The tapping of screws with new and sharp dies, and great care and slowness, is undoubtedly one of the best, if not absolutely the best method of making a good and true screw. But it is found that when a stock is worked by hand, there is generally a stopping place perceptible on the screw itself, where the workman changes hands, which is most probably the chief imperfection that produces inaccuracy when such screws are set to subdivide their own threads. If one handle be more

depressed than the other, the screw will have a periodical variation of obliquity, which workmen call a drunken screw, and it is difficult to avoid this error where the screw is short.

As the dies at best cut rather by the force of the setting screws than the keenness of their own edge, they not only bend the tap or screw, but scarcely ever take equally off from all sides. The best remedy for this is to use long dies; but even with these, a centred and turned tap will seldom prove straight and round after it has received the thread.

In minutely considering the action of the dies it will be seen, that the opposite sides of the thread incline towards different regions, and therefore, in effect, cross each other. Hence it is impossible for the dies to be made to approach each other in the plane of the helix. (A tangental plane to the helix having a vertical axis, will in fact revolve round the axis itself, preserving a constant angular inclination to the same.) But the dies approach in a plane at right angles to the axis. It follows, therefore, that there are limits to diameter, depth of cut, and inclination, beyond which the dies cannot operate. These limits are the cause why a true flat thread screw cannot be cut in dies; and a many-threaded screw, or screw of great obliquity, in a single pair of dies, is impracticable, and can only be cut by a succession of different pairs of dies.

If dies are not well fitted in the stock, and the stuff be veiny or unequally hard, they will yield to the hard parts, and by the effect of this shake produce an undulated thread. Long dies do indeed greatly remedy this imperfection; but it must always exist, however small.

As a pair of well fixed dies can never both run along the same stroke till quite home to their natural place, the cut made by the one will tend to draw the other along the cylinder, so that while one die cuts the upper side of the thread, the other die will cut the opposite or under side. In this cross action the frame and the dies themselves will

yield from elasticity, and that the more, where the stuff is most hard or the work forced. Hence, with a like pressure, the soft side will have the widest cut, and be soonest cut down, and the sides of the thread will be waving. This seems to be the chief reason why tapping a screw throws it out of centre and roundness.

It is found by experience, in the attempt to tap a screw much larger than the original of the dies, that the corners of the dies taking hold first, are nearly indifferent as to the run; and if left to operate without pressure in the line of the axis, would as probably cut mere rings, or a left-handed screw, as the right-handed screw (supposed to be in the dies). In these circumstances, therefore, the thread at first turns out to be wavey, with very little rise in the run of each corner, until it suddenly falls into the cut made by the corner it follows. Each turn consists accordingly of four waves, which are amended as the dies sink deeper, and are led by their own slope. But it may be questioned if these waves, once produced, are ever completely removed, so that the screw probably approximates to the truth, without ever attaining it. And in the nature of the operation of tapping, this error in the first instance can only be diminished, but not absolutely removed, because all cutting is begun by the corner of the dies.

Having enumerated what appear to be the several causes of the existing imperfections of screws in general, it may naturally be expected that I should point out some means of obviating at least a portion of the obstacles enumerated. But this I think will not be found so easy a task, and I shall merely describe one method which I have tried with success, and content myself with having partially investigated a subject of the utmost moment to the mechanic, considering that the first steps towards improvement are by the deliberate investigation of the obstacles to be overcome.

In the tapping of a deep flat-thread screw, the breadth of the die, or portion of circle it contains, must be small,

because, in a large circular part, the run of the dies is very great from the corner first taking, to the proper or finished position, whence the corners are found to spoil the thread. I have therefore used four dies, in a kind of double stock, having two grooves at right angles, each die being pushed forward and withdrawn by a single screw of the same tap. These screws, which act on the several dies, have each a pinion or small wheel, of the same size and number, which rise above the plate on one side of the stocks, so as all to be moved by one contrate wheel, large enough to present a milled edge or proper hold to the workman. Six or more grooves may be better for large screws. But though this contrivance has partially obviated some of the objections before enumerated, in the manufacture of screws, much remains to be done, and I trust some means may be devised for rendering screws of every description more perfect.

London, Sept. 7, 1825.

Our correspondent will find a paper on cutting screws, by the Rev. Mr. Gilbert Austin, in Repertory of Arts, first series, Vol. II. p. 399, to which we beg to direct his attention, for methods for the purpose, not generally known to workmen. We would also suggest, that improvements might be effected in the cutting part of the tap, or additions be made to it for cutting on some better principle.

Report of the Select Committee of the House of Commons, appointed to inquire into the state of the law and its consequences respecting the Exportation of Tools and Machinery. (Continued from p. 169.)

It is also worthy of observation, that although so early as the year 1497, woollen cloth was one of the greatest articles of exportation, and is so considered in a supplementary treaty of commerce concluded in that year between Henry 7th and the Archduke Philip, Sovereign of the

Netherlands; and although that manufacture continued to be a staple of great importance to this country, arising partly perhaps from the quality of the wool, and partly from the improvements in our machinery, yet no legislative enactment was deemed necessary for its protection, as regarded the implements used, till the year 1750, when the 23d Geo. 2d, c. 13, was passed, in order to prohibit the exportation of the tools or utensils employed in its fabrication. An interval of more than half a century had thus elapsed, during which period no interference on the part of the legislature to prevent the exportation of any kind of tools appears to have taken place. In the same act, however, of 1750, prohibiting the exportation of tools or utensils used in the woollen trade, there is most unaccountably included a prohibition of the tools or utensils employed in the silk trade, although, at that period, the manufacture of silk in this country was still in its infancy, and the implements and tools in use in Great Britain confessedly inferior to those on the Continent.

It will be in the recollection of the House, that one of the principal objections made in the last Session of Parliament to the importation of silk manufactures, was the alleged superiority in implements and tools possessed by the manufacturers on the Continent; a strong proof, in the opinion of your Committee, of the folly of prohibiting by the act of 1750 what there could not be the smallest inducement to export, and of the total absence of any sound principles or correct data in the commercial legislation of that period.

The 14th Geo. 3d, c. 71, (1774,) the next act on the statute book, exhibits a similar inconsistency in prohibiting the tools and utensils used in the *cotton* and *linen* manufactures, or a mixture of either. It is well known that in France, Germany, and other parts of Europe, the linen trade had then arrived at a very high degree of perfection, and that, whatever precautions might have been deemed necessary in regard to our improvements in cotton machi-

nery, no tool or utensil possessed by Great Britain at that period, for the manufacture of linen, could have been an object of importation on the Continent.

Your Committee cannot pass over the act of the following year, 15th Geo. 3d, c. 5, (1775,) without observing, that it permits the exportation of wool cards, or stock cards, and spinners' cards, to the British Colonies in North America; because, says the act, "the prohibition to ex-"port them had proved extremely prejudicial to great "numbers of poor families in England." And your Committee may be permitted to remark, that every prohibition of the same kind, if not followed by the same consequences, has at least been productive of no apparent benefit to any part of the community.

Although actual injury to the industry of the country had thus become evident, in one branch, from restraining exportation, the legislature, in compliance with the application of several manufacturers, proceeded, by the 21st Geo. 3d, c. 37, (1781,) in the spirit of former enactments, to forbid, not only the exportation of all tools, but also of all models and plans connected with the *wool*, *cotton*, *linen*, or *silk* manufactures, under a penalty of 200*l.* for each offence, and the forfeiture of all articles so prohibited, if attempted to be exported.

A further prohibition took place in 1782, by the 22d Geo. 3d, c. 60, of all *blocks*, *plates*, *engines*, tools, &c. used in the *calico*, *cotton*, *muslin*, or *linen printing* manufactures; and in 1785, by 25th Geo. 3d, c. 67, the *iron* and *steel* manufactures appear, for the first time, to have occupied the attention of the legislature, and a long list of tools and utensils, including, in fact, almost every tool or utensil that could be used "in repairing, working, finishing, or "completing the iron and steel manufactures of this king-"dom, by whatever name or names soever the same shall "be called or known, now or at any time hereafter, and "also of any models or plans of any such tool, utensil, or "implement," under severe penalties, as if to prevent the

industry of the country from being employed in the manufacture of any of those numerous articles required for any other part of the world than the United Kingdom.

That act would appear, however, to have had a particular reference to the *button* and *buckle* trade, which the legislature seems to have been anxious to monopolize for this country, as almost every tool employed in their manufacture (as will be seen in the Appendix), is especially designated; but the buckle trade may be said to have entirely ceased along with the fashion which gave it birth, notwithstanding these bolstering precautions. With respect to the button trade, great improvements have been made in those kinds used for home consumption; and though our manufacture of them is equal, if not superior to any in Europe, yet it appears, by the evidence of Mr. Osler, from Birmingham, that the fancy button trade is almost entirely lost to this country, notwithstanding the precautions of this act to retain it. From his statement, on the authority of Mr. Ledsam, one of the largest button manufacturers in Europe, it would appear that England at one period supplied France, Germany, Italy, and Switzerland with buttons; and that in Birmingham alone 20,000 gross were made every week for the foreign market. The reasons assigned by Mr. Osler for the loss of that trade, partly explain the cause; namely, that copper could be obtained on the Continent at 60 per cent. less than in England, owing to the protecting duties imposed in favour of the mining interests in Cornwall; and that the stamp duty on silver, and other charges, raised the price of the article so as to render competition with the French and other manufacturers utterly impossible: an additional proof, if any were required, that the low price of any article of equal quality, is a better security for an extended market than any legislative restriction on exportation of the tools employed in its manufacture.

Your Committee have deemed it proper to notice this act (25th Geo. 3, c. 67) the more particularly, as being

the most comprehensive and sweeping in its enactments against the exportation of tools, in order that the House may judge of the inconsiderate manner in which it must have been passed, as by the acts of the following year (26th Geo. 3, c. 76 and 89) it is repealed, and another long list of exemptions (inserted in the Appendix) enumerated, which render the law at present so complicated, that, exclusive of the difficulty of discriminating the particular kinds of machinery, as stated in the evidence, it is extremely difficult, if not impossible, to ascertain what are and what are not prohibited.

It is deserving of notice, that by the 26th Geo. 3d, c. 76 (1786), it is declared that, "as the exportation of "wool cards to North America had been beneficial to this "country, and as the allowing of a general exportation "thereof to foreign parts will be highly serviceable to a "great number of poor families in England, employed in "the trade of making such wool cards," the same were then and are now allowed to be exported to all parts of the world.

Neither the grounds on which these acts were passed, and repealed, nor the advantages expected to be derived from them, appear to have been well understood; as by the 25th, (c. 67,) the prohibition was perpetual, whilst by the 26th, (c. 89,) it was provided that the prohibition should only continue in force till the end of the next session of Parliament, and *no longer*.

Your Committee beg leave to state their opinion, that changes in laws which regulate the export and import of any article, should be made as seldom as possible, as by every change new establishments and connections in commerce must necessarily be formed; and, exclusive of the loss of capital consequent thereon, the uncertainty to which they give rise in the minds of merchants and manufacturers must greatly tend to impede the commerce and check the prosperity of the country. Many able and intelligent men have even gone so far as to assert, that it

is often much better to submit to inconvenience and loss than to make a sudden change in any extensive branch of the industry of the country, although that change might ultimately remove the inconvenience and loss suffered; yet so great has the uncertainty been as to what line of conduct the legislature would ultimately pursue, that the statute book affords, in the instance of machinery, a notable example of the total want of any fixed principle; exhibiting, in the same year, one act to permit the exportation of one kind of tools, because their prohibition had proved injurious to the industrious classes of the community; and another, prohibiting the exportation of other kinds, because such exportation was considered to be detrimental; and the provisions of that act, which would have expired in 1787, were continued from year to year by the 27th, 28th, 29th, 30th, 31st, 32d, 33d, 34th, till, by the 35th Geo. 3d, c. 38, it was rendered perpetual.

These acts also prohibit the exportation of all tools, implements, and machines, used in coining money, although it would be extremely difficult to show why any country should have impediments thrown in its way for coining money for its own use, or what possible injury this country could sustain from supplying other nations with the various and expensive machinery which is necessary in large quantities to the establishment of mints. No permission, however, appears to have been granted by legislative authority for this purpose, except in one solitary instance, namely, in that of Mr. Matthew Bolton, an engineer of Birmingham, who, by the 39th Geo. 3d, c. 96, (1799,) was permitted to export the machinery necessary for the erection of a mint in the dominions of the Emperor of Russia, and to send workmen there to erect the same. But His Majesty's Government, as appears by the evidence, have, under the exigencies of the case, thought it right from time to time, on special applications, to grant licences for the exportation of different articles of machinery to various parts of the world.

The Committee, in 1824, examined many practical men for the purpose of ascertaining how far, in their opinion, the prosperity of our manufactures had been promoted by the laws which prohibit the exportation of tools and machinery, and how far the improvement of the manufactures of other countries had been thereby retarded. Many of these witnesses were of opinion, that considerable advantage had accrued to this country from the protection which these prohibitory laws gave to our manufactures, by their operation in preventing foreign nations from becoming our rivals in several branches of manufactures: but a careful perusal of their evidence will best show the grounds on which those opinions are founded.

In addition to the examination of persons practically conversant with machinery and manufactures, that Committee called before them, and examined, two gentlemen eminently qualified to determine, on general principles, the policy of prohibiting the exportation of tools and machines. These gentlemen gave their reasons at length for believing the prohibition to export tools and machines to be injurious to the commerce and manufactures of this country, inasmuch as we thereby shut ourselves out from a new branch of business which would give employment to a large number of our people, increase our own capabilities, add considerably to the amount of our productions, and consequently to the increase of capital; particularly so, as the materials of which tools and machinery are made are almost entirely the products of our own soil, and may be procured by the labour of our own people in unlimited quantities.

Your Committee beg leave, however, to call the attention of the House more particularly to their evidence, which contains matter of the greatest importance, as it explains many of the grounds on which, in the opinion of those gentlemen, commercial intercourse, in order to be prosperous, should be founded.

Another circumstance of some moment, to which your Committee beg leave to request the attention of the House, is the commercial jealousy which the prohibition to export tools and machines is calculated to perpetuate, and the effect which the repeal of these laws would produce on the policy of other nations towards us, and how far the removal of all such causes of jealousy would operate in respect to many regulations and restrictions now existing on commerce, which the members of every enlightened government must necessarily wish to see removed, and which the legislature appears to have had in view in the late various important alterations in the commercial relations of this country.

The evidence taken by the Committee in the last Session was such as to induce them at that time to decline recommending any measure to the House beyond that of a renewal of the inquiry in the present Session; and in order to make this inquiry as complete as possible, the Chairman of your Committee caused a notice (inserted in the Appendix) to be sent to the principal municipal officer and chambers of commerce in many of the great manufacturing towns of the United Kingdom, some of whom, it appears, caused it to be inserted in several of the provincial newspapers.

It is necessary to observe, that notwithstanding this public notice, no person from any of the manufacturing districts has requested to be examined before your Committee; and that only two answers to his circular were received by the Chairman; one from the Chamber of Commerce in Birmingham, inclosing a copy of the resolution of that Chamber, of the 12th of March, 1824, which objected both to the emigration of artizans and to the exportation of machinery; and as the evidence of the witnesses deputed by that Chamber at that time will be found in the minutes of the Committee of last year, it is presumed that they had no additional evidence to offer; the other from

the master cotton spinners of the county of Renfrew, appointing Mr. Dunlop (whose evidence on the subject will be found in the minutes of last year), to oppose any bill for permitting the exportation of machinery. As no person, therefore, came forward from the country to offer evidence to your Committee, it was necessary more particularly to revert to the evidence taken by the Committee in the last Session, for the purpose of more fully showing its tendency.

Almost all the principal engineers whose factories are situated in the metropolis, were examined. Their evidence tends to show the injurious consequences of the laws which prohibit the exportation of tools and machines, and all of them concurred in recommending their repeal. Several machine-makers, resident in the country, were also examined before the Committee, all of whom agreed in recommending a revision of the laws, or that particular kinds of machinery might still be legally exported, while other kinds might be prohibited. They also concurred in opinion that much of the machinery at present prohibited might be advantageously exported; but gave it as their opinion that other kinds of machinery, and particularly those used in the manufacture of cotton goods, should not be permitted to be exported. This opinion was grounded on an apprehension that foreigners might in time be able to manufacture such goods, not only for their own use, but also for exportation, cheaper than we could, and might thus supersede us in the foreign market. They were also apprehensive that the orders which might be received from abroad for tools and machines, would raise their price at home, and prevent our own manufacturers from being supplied with the machinery they wanted; and several manufacturers concurred in these opinions.

The objections made by the machine makers and manufacturers were thus reduced to two: viz.

1st, That in consequence of the large foreign orders which

would probably be sent from abroad, the price of the tools and machines, if the free exportation were permitted, would be considerably and permanently raised at home.

2d, That it was to be feared that, in a short time after the repeal of those laws, foreigners would be able to undersell us in cotton goods, in lace made in frames, and in some other branches of manufacture.

To these two principal objections your Committee more particularly turned their attention; and in the evidence of all the London engineers it is distinctly stated, that they do not believe that any considerable rise of price would, for any length of time, follow the repeal of the prohibiting laws. On this subject, however, your Committee submit to the consideration of the House an extract from the evidence of Mr. Alexander Galloway.

"Do you then think that we should secure a very con-"siderable and profitable branch of permanent manufac-"ture, without injuring our home manufactures, if this "law was repealed?—I am decidedly of opinion we should "improve our condition; and if I was a considerable ma-"chine user in any of our principal manufactures, I should "say I should be very much benefited by taking off the "prohibiting laws, as it would ultimately lessen the price "of machinery.

"Do you mean by the increased competition and skill "that would be brought into action?—Yes; and that will "all end in making machines cheaper. At first it may "increase the price with certain individuals, but not with "the manufacturers generally; and ultimately it will in-"crease the means by which machinery is produced."

The principal difficulty which seemed to your Committee likely to occur, from any considerable increased demand for machines from abroad, was the number of hands which could in a comparatively short space of time be procured to meet the demand.

It has always hitherto happened, and on general prin-

ciples it may safely be affirmed that it will always happen, that where a commodity can be supplied in unlimited quantities (which machinery may be in this country) a large increase in the demand never fails, after a very short period, to reduce the price; but the necessity of instructing men in machine-making seemed to oppose an obstacle which it would require much time to overcome; and it was upprehended that in the mean time the price of machines might be considerably increased. The opinion, however, of the London engineers was, that no difficulty whatever would exist as to the procuring of hands capable of constructing machinery in any quantity which could be required; and that, too, greatly to the advantage of a large number of persons.

Messrs. Martineau, Bramah, Maudslay, and Galloway, all of them eminent in their profession as engineers, affirm that men and boys in almost any number may be readily instructed in the making of machines, and that the great improvement of the tools used for making machines, and for the abridgment of labour in many important parts of the business, (which enables them to employ common labourers, who may rapidly become skilful workmen) furnish reasons for believing that the price of machinery is much more likely to be reduced, and that in a short time, than increased by any considerable extension of the business of machine-making. Your Committee would, however, call the attention of the House to the evidence of Messrs. Ewart, Kennedy, and other witnesses from the country, who have expressed a contrary opinion, in order that a correct judgment may be formed on the subject.

To be continued in our next Number.

On the Extraction of Opium from the indigenous Poppy.

By M. Laine.

From Bibliothéque Universelle.

In October, 1821, the author had a considerable space sown with poppies of the kind called *blind* poppies, disposed in rows two feet asunder. Although these poppies made a very indifferent appearance in the spring, they greatly improved afterward, and every one produced from 8 to 20 capsules. In April the ground was dug and raked, and in May the plants were earthed up. Most of them grew to the height of four feet and a half.

The method followed by the author to gather the produce, consisted in making incisions in every head or capsule, with an instrument formed of two blades or edges, fitted into a little wooden handle, so as not to project beyond it more than about a quarter of a line, the incisions being as much as possible in a spiral direction. Children followed the person who cut the poppy-heads, and gathered the milky juice which escaped with a small brush or pencil, the size of the little finger. When the pencil was full of juice, they pressed it with a finger against the inside of a little tin vessel, in the same way that painters press the oil out of their brushes in order to clean them. At the end of every half day's work, all that was collected was put together into a flat vessel, where it was left to evaporate to dryness.*

* The *milky juices* of vegetables owe, in general, their milky appearance to a certain quantity of resin or of fatty substance which they hold in suspension. They likewise frequently contain different substances soluble in water, particularly mucilage.—See Annales de Chimie, Vol. XLV. p. 257; v. 21, 275, and 288.

NOTICES OF NEW PATENTS.

Patent granted to WILLIAM CHURCH, *of Birmingham, Esq. for certain improvements in casting cylinders, tubes, aud other articles of iron, copper, and other metals.* Dated January 18, 1825.

THE plan for which this patent was obtained, consists of exhausting the air by air-pumps from the moulds, prepared for receiving the melted metal so as to be air-tight, and forcing the melted metal from air-tight vessels into those exhausted moulds, by the action of compressed air, impelled by air-pumps over the fluid metal. The patentee states that there are many methods of doing this, depending on the nature of the castings and moulds, which cannot be all described; but gives the following example of the mode of applying his plan in casting iron rollers.

The mould is to be inclosed in an air-tight case of cast iron, from the bottom of which a tube of earthen ware (such as is used in making crucibles) is to descend, and from its top a pipe is to pass to an air-pump (which is represented in the drawings of a large size in proportion to the mould), and beneath which is an air-tight vessel, which may be exhausted by it, and whose use is to accelerate the process of exhausting the mould, by previously pumping the air out of it, and opening the communication between it and the mould, which is made by continuing the pipe from the air-pump to it, and having cocks so placed in its passages, that the air may pass from the mould either to the pump or to the vessel, by opening some cocks and shutting others, as the occasion demands. The pan containing the melted metal is placed beneath this mould in an iron chest, with charcoal dust between the two, to retain the heat, and the earthenware tube of the mould passes down into the melted metal, through a circular lid with conical edges, that closes the chest so as to be air-tight, an expanding ring of metal being placed between the two,

to make the junction more perfect; but how it effects this purpose is not sufficiently explained, or the manner in which the lid is pressed down on the top of the chest, though this latter may be more easily conceived; the air-pump before-mentioned being constructed so as to act as a forcing pump as well as an exhauster, and a pipe passing from it to the chest that holds the pan of fluid metal, and a cap of metal that will readily melt being put on the end of the earthen tube, and that being passed through the lid of the chest, and its juncture with it, as well as that of the latter, with the chest, being all made air-tight; the earthen tube descending through the melted metal within an inch of the bottom, and the mould being previously exhausted; as soon as the cap is melted of the earthen tube by the red hot fluid metal, this latter will begin to ascend through it into the mould, and at the same time the air-pump, being worked so as to force the air into the chest that contains the pan of melted metal, its pressure will accelerate the rising of the fluid metal into the mould.

A pipe is represented passing off sideways into the vessel beneath the air-pump already mentioned, from the pipe that goes from the pump to the chest, and a cock with three ways is placed at the joining, so that the passage to the pump, or to the vessel, may be opened from the chest as desired.

Round the metal case of the mould another external case is exhibited in the figure, with a cock near its bottom, the use of which is to admit cold water round the mould, to cool the casting more rapidly, when it is expedient to case-harden its surface.

The mould is furnished with gudgeons for attaching chains, by which to lift it into its place over the fluid metal by one of the cranes commonly used in founderies; and the pipes have union joints, in the proper places, for connecting them together, to form the communication with the air-pump described, when the mould is lifted into its place by the crane.

There may be cases of peculiar castings, having very minute parts, or complicated ramifications, or whose surfaces require uncommon accuracy, where this apparatus would be of great use; but for general purposes it is obviously too expensive; nor do we believe it was intended for such, the common methods having been brought to very great perfection for them. We believe the statement of the patentee to be perfectly correct, that castings made in his method will be less liable to flaws, hollows, or minute cavities, called honey-combs, and other defects; and therefore it is probable that, as well as to the uses which he mentions by name in the title, this plan might also be applied beneficially to the casting of cannon, and to the highest branch of the founder's art—the making metallic statues.

It is probable that the vessel beneath the air-pump is intended by the patentee to hold compressed air occasionally, though not expressly mentioned by him, on account of the pipes from the chest, that holds the pan of melted metal, having a communication with it near its upper extremity.

Patent granted to Samuel Crosley, *of Cottage Lane, City Road, Middlesex, Gent. for an improvement in the construction of gas regulators or governors.* Dated February 1, 1825.

Mr. Crosley commences his specification with an account of two other methods before used in the construction of gas regulators. The first is formed like a small gas holder, moving in water as usual at its lower extremities, but having a rod suspended from the centre of its top, ending in a cone, whose broadest part is placed downward, and lies below a round aperture in the bottom of the gas holder, through which the gas enters from a lower compartment of the apparatus, and which this conical stopper reduces in extent as it is raised up by the elevation of the upper part of the gas holder.

The other method consists of an implement formed like a bellows, having a round aperture in its lower plank, which is reduced in size by a conical stopper, suspended by a rod from its upper plank, in a similar manner to that described, and which closes its capacity in proportion as the bellows part is inflated by the entrance of the gas, and the top plank is thereby elevated.

Mr. Crosley's improved gas regulator consists in a cup or vessel, which he improperly calls "a tank," whose mouth is covered with gold beaters' skin, oiled silk, or any similar flexible substance, so as to exclude the passage of air. This flexible cover is, however, not to be stretched tight, but is to have that degree of relaxation which will allow of its centre being moved up and down sufficiently to have the same action on a conical stopper, similarly constructed, and suspended in the same manner as those described, which reduces or enlarges the extent of an aperture in the bottom of the vessel, through which the stem of the stopper passes, in proportion as the flexible cover is raised or depressed by the action of the gas, that flows through it from a lower compartment of the gas regulator, into which a pipe passes from the large gas reservoir; while another pipe, that goes out from the side of the vessel, conveys it to its destination.

Small disks of pasteboard, or of other proper material, interposed between the centre of the cover and a flanch, near the top of the stem of the stopper, and through which it passes, serve to make that part gas-tight, when pressed together by a screw and nut on the top of the stem. The edges of the cover are also made gas-tight by a flat ring that lies above them, over the mouth of the vessel, to which it is pressed down by screws that pass through both. Above the flexible cover is fitted a case to secure it from injury, so constructed as to allow sufficient space for its motion upwards.

Weights may be fastened on the upper part of the stem of the stopper, above the flexible cover, to regulate the

degree of pressure of the gas by which the aperture beneath is to be closed.

This regulator will form an instrument of sufficient delicacy and lightness of operation to be used with single burners, for which purpose we suppose it was intended, though the patentee does not declare his design in this respect.

We think the stopper would move more steadily up and down, without being liable to lateral motion, by having its stem passed through a hole or ring, in the middle of a wire, fixed across the aperture in the bottom, and sufficiently below the flexible cover not to interrupt its movements.

We object to the cup or vessel of this regulator being called a "tank," because this word, which we have imported from the East Indies, really means a large artificial pond of water, and therefore is not a proper appellation for a small vessel, either directly or figuratively.

Patent granted to WILLIAM RHODES, *of Hoxton, Middlesex, Brick-maker, for an improvement in the construction of clamps for burning raw bricks.* Dated November 20, 1824.

MR. RHODES, in the beginning of his specification, gives an account of the common method of making clamps of bricks; in which, after describing the way in which the clamps are raised with courses of *raw* (unburnt) bricks, stratified with cinders, or *breeze* (small cinders), inclosed by walls of inferior burnt bricks outside, he states that the whole is covered at top by three or four courses of soft burnt bricks, placed flat and close together, and arranged so that those in one course shall cover the interstices of the course directly beneath, which is commonly called *breaking the joints.* These bricks so placed are called *cantlings* by the brick-makers. Above these courses, three

or four more courses of the same sort of bricks are placed *edgewise*, but arranged in every other respect as the former, and these latter are called *plattings*.

The use of these upper courses is to protect the raw bricks from rain, which it is highly necessary to keep off; for if the raw bricks get wet, it is found that they can never be burned hard, and will only produce the sort called *shuffy* bricks.

This covering the patentee states effectually kept off the rain, and yet there were always some courses of shuffy bricks, found at top of the clamp when burned, beneath the covering, by which a considerable loss was incurred. This the patentee attributed to the steam from the raw bricks, at the bottom of the clamp, ascending when the fires were kindled, and condensing on the raw bricks in the upper courses, on account of their being colder than those beneath, which induced him to try methods to prevent this evil, of which the following one succeeded to his satisfaction, and is the object of his patent.

The clamp being built as usual to near the top, the patentee sets the two or three last courses of raw bricks about half an inch asunder, and fills these interstices with breeze; over these he places one course only of *cantlings*, arranged with the species of intervals between them, called *pigeon holes*, continued from one end of the clamp to the other. Above these, he places three courses of *plattings*, the lowest course of which are at every 14 or 15 feet to be *pigeon holed* across the clamp; and he covers the whole, particularly at the end of the brick-making season, with 3 or 4 inches of brick dust or soil. By this method, in the first place the steam gets vent completely through the *pigeon holed* passages, lengthwise in the course of *cantlings*, and crosswise in those of the *plattings*; and secondly, the heat produced by the burning breeze in the upper courses of the raw bricks, both prevents the steam from condensing on them, and burns them more completely; and lastly,

the covering of soil or brick dust secures the whole better from rain, and more effectually reverberates the heat.

The method of constructing brick clamps, proposed by the patentee, seems very judicious, and founded on just principles; but such are the variety of methods in which bricks are arranged in the clamps in different parts of this country, and so various are the ways in which they are covered, that the chance must be very great of some of them being sufficiently similar to the method of the patentee to render it very doubtful whether he could sustain his patent, and to make it more prudent for him therefore to look for profit from his method of brick-making, to the advantages it must produce in his own practice, or in directing the construction of clamps for other brick-makers, for which he has proved himself eminently qualified, by his observations on brick burning in his specification, as well as by his proposed improvements.

Patent granted to WILLIAM SHELTON BURNET, *of London-street, Merchant, for a method of lessening the drift of ships at sea, and better protecting them from gales of wind.* Dated January 11, 1825.

THE method of lessening drift of ships, recited in the specification of this patent, is by letting down to the windward a square plane, attached to a floating plank, with chains eleven feet long from the angles at one side to those at the opposite sides, connected in the middle by a loose ring, to which a hawser is to be fastened from the ship; a cord also passes to the ship from each end of the plank to direct the position in which this is to lie with respect to it. The square plane being directed by the cords to lie at right angles to the drift of the ship, and not being moved by the wind from lying very low in the water, will of course, in being drawn forward by the

hawser, make a resistance to the motion of the ship to the leeward, proportional to its hold in the water, which will be equal to its surface multiplied by the square of the velocity of its movement.

The square plane consists of a frame of bar iron, bolted to the plank, with strong canvass, turned over and sewed to the upper bar of the frame, and laced by cords passing through holes in it, to the bottom bar and to those at the sides. The plank is a little more than three times the length of the frame, and is formed of three pieces, united by hinges at each side of the frame, with bolts over the hinges, so arranged that when the two outside pieces are opened up so as to be in a line with the middle piece, the bolts, being protruded, will keep them in that position; and when they are drawn back, will admit those pieces to be brought down by the sides of the frame, in order that the whole may take up less room in stowage, when not required for use. The chains connected by the ring in the middle, and drawn by the hawser, will pull the whole forward equally, without permitting one part of the frame to be acted on more than another by the resistance of the water. The dimensions of the frame are not mentioned, but from the length of the chains being eleven feet, it is supposed it could not be more than about seven feet long at each side.

This plan was first proposed by Dr. Franklin, who took the idea of it from a school-boy's kite, and had an apparatus for the purpose fitted up in the same manner, and very like one, an account of which may be seen in the Transactions of the American Philosophical Society. The dimensions proposed by the Doctor for the plane, as well as those inferred from the description of the patentee for his, seem much too small to be of any effectual use for the purpose intended.

Patent granted to Mr. Francis Gybbon Spilsbury, *of Walshall, Staffordshire, for improvements in tanning.* Dated April 22, 1823.

For Mr. Spilsbury's method of tanning, oblong square frames are provided, with metal loops fastened round their edges. On one of these a skin or hide is stretched, after being limed, cleansed, and prepared in the usual manner for tanning. Over this hide another of the frames is placed, then a second hide is laid above it, and a third frame is put above that. The three frames are arranged so that the metal loops of each shall be opposite those of the others; screw bolts are then put through those loops, and screwed up sufficiently tight to prevent any liquor from passing between the frames and the hides. The whole is then set up edgeways, and there being two short pipes, furnished with cocks, in the upper edge of the middle frame, a pipe, in which there is also a cock, that descends from a cistern holding tan liquor, is fastened to one of these by a union joint; and another cock being placed near the bottom, in the same frame, to let off the liquor when required, completes the whole apparatus.

The cock at the top, that communicates with the tan cistern, being opened, and the other near to it being also opened, while that at the bottom is shut, the tan liquor will run down between the hides, driving out the air at the other open cock; which, as soon as any liquor appears in it, being shut, the tan liquor will then distend the hides and press outwards, with a force proportional to the height which the tan cistern is elevated above the frames. The consequence of which pressure will be, that the tan liquor will ouse through the pores of the hides, appearing at the outside like dew; and by thus bringing fresh portions to act continually on them, will, in the opinion of the patentee, cause them to be tanned much more speedily than happens in the common method, in which the hides lie in the liquor, after it has ceased to operate on them, and are only passed into fresh liquor at intervals by a tedious manual operation.

The frames are to be made of wood or copper, and if iron should be used for them it must be well painted, to prevent its making the hides black.

In some cases two skins or hides may be put at each side of the middle frame; and when the whole are well tanned, the tan cock is to be closed, the liquor is to be run off at the lower cock, and the frames separated from the tan pipe and from each other; and the hides being removed, and having their edges pared off, which were nipped or compressed between the frames, are then to be dried and finished in the usual manner.

Nothing further is stated in the specification respecting the time which this process will require, but that it must depend entirely on the nature of the hides or skins.

This method of tanning has attracted much attention; and it is reported that hides of that thickness to require a year for tanning in the common method, can be finished in this in six weeks; and that some skins can be tanned by it in eight or nine days; it is also said, that a very large sum of money has been offered for the patent right.

The theory of the process appears to promise well for quick performance, but on these occasions it is necessary to attend to facts; and we have been informed by some gentlemen in the trade, that the hides are not tanned evenly by this method, but leave spots less acted on by the liquor than the rest; and that leather made in this way is not so durable as the common sort.

The quantity of the hides that must be pared off when they come out of the frames, must certainly diminish the value of the process, and especially when oblong-square frames (such as are represented in the figures of the specification) are used, which, not being of the natural shape of the hides, must cause more waste; which must be worth consideration, even though the parts to be cut away are the least valuable of the hides.

It must, however, be considered, that this method of tanning is still in its infancy, and that it will be probably improved in time, so as to diminish some, and totally remove others of these objections made to it.

Patent granted to Mr. Josiah Parkes, *of Manchester, Engineer, for a method of manufacturing salt.* Dated December 4, 1823.

This method of manufacturing salt consists in using a boiler for the purpose, of a very singular shape, contrived to let the salt fall below the level of the fire-place, from whence it is drawn off through a cock, along with a portion of the brine, instead of being taken out by rakes and shovels in the usual manner.

The boiler is to be made of a conical form, having its height equal to its extreme breadth, and obtruncated so as to leave an opening of the extent of one fifth of the diameter of its base towards its apex. This conical part being placed with its base upwards, a cylindrical vessel, of the breadth of this opening, and twice its depth, is attached to this part, the bottom of which vessel is likewise of a conical form, and terminates in a cock.

The top of this boiler, which in this position is its broadest part, is covered with a dome; above which rises a short cylinder, large enough to admit a man, which has a cover screwed down on it, in which is placed a safety valve; and from its opposite sides issue two tubes, to convey the steam to the open air. This boiler, with the cylinder appended, having its parts connected with rivets and screws in the usual manner, and being made of the usual materials, is set in brick work, and partly supported by a projection at its largest periphery, and partly by a broad circular plate, placed below its cylindrical termination, and perforated so as to permit the conical bottom of this part to pass through. This plate is represented in the figure three times the breadth of the cylindrical part of

the boiler, and resting on an arch into which its conical bottom and its cock passes. A ring is attached to the top of this cylindrical part, and another ring being placed outside of about thrice its diameter, concentrical with the first, joggle bars are laid between them in the lines of the radii, to support the fuel; and the fire-place is constructed round this larger ring, having an opening at one side furnished with an iron door to admit the fuel, and an ash-pit all round of the depth of the cylindrical vessel which it encloses, and of the breadth of the grate. Above the fire-place, spaces are left all round between the boiler and the brick-work, for the passage of the fire and smoke upwards, from which a flue conveys the latter to a chimney.

Above the boiler at one side is placed the cistern, which holds the brine, and from it a pipe descends to the level of the bottom of the cylindrical termination of the boiler, into which, at this part, a branch from the first pipe proceeds, and another branch passing from the same pipe to the top of the boiler near the dome, all three being furnished with stop-cocks, completes the apparatus.

The whole being constructed as described, the boiler filled with brine from the cistern by the pipes, and the latter brought to boil by a due application of fuel in the fire-place, the salt, which will soon begin to form as the water evaporates, will descend through the less agitated part of the liquor in the centre, down into the cylindrical vessel beneath the fire-place; and when it is judged that a sufficient quantity of it is there accumulated, the lower pipe is first opened to let in cold brine about the salt, and cause the hot brine to ascend from it, which it will do by being of less specific gravity, and then the lower cock in the archway is opened, and the salt drawn off through it into baskets, along with a portion of the brine, which is received into a proper vessel placed beneath the baskets, and is pumped back again into the boiler or the cistern.

The advantage proposed by the patentee by this form of boiler, is to prevent the salt from sticking to it, which he takes for granted the obliquity of its sides will effect, added to the action of the heat impelling the liquor, and it from them, towards the centre.

It is stated at the end of the specification, that this boiler may be heated by steam, or by heated air and smoke passing from fire-places of other boilers, as well as by having fuel directly applied to it, as mentioned; in which mode of managing it, a case should surround it of iron, or other proper materials, to confine the action of the heated medium, so as to make it have most power. And the whole concludes with the usual clauses relative to variations of shape, producing the same effect, being within the limits of the patent; and with the negation of claim to such parts of the apparatus and process, as have been before used, and are not immediately concerned in promoting the design of the patentee.

The boiler proposed by the patentee is certainly of a kind very little favourable for evaporation, both on account of its great depth, the obliquity of its bottom to the fire, and from its being covered at top from the action of the air; but if it would have the effect, which he supposes, of preventing the adhesion of saline matter to its lower parts and sides, there might be situations where fuel was sufficiently cheap, to make the additional quantity of it, which this boiler would require, less an object than the saving which would from this be produced in the wear and repairs, which we understand for the common salt-pans occasion a considerable expence.

Were the brine composed of a solution of muriate of soda alone, the boiler of the patentee would probably be little affected by adhesions; but as it always contains a mixture, more or less, of various calcareous, argillaceous, and magnesian salts, whose bases have a strong attraction to iron, as well as their acids (in which latter it is so

great as to decompose some of them, particularly those of which alumine forms a part), we think the shape of the boiler could not prevent this attraction from taking place, and causing adhesion to a certain degree, which, however, would probably be a great deal less than in the common flat pans.

The use of steam in evaporating, proposed by the patentee, would certainly tend greatly to preserve the boilers, as it would prevent them from getting that high degree of heat, which does them such mischief when adhesions occur, and hardens these latter so as to make much force necessary in their removal. But this is by no means a new application of steam, several others having before used it in this way; nor does it appear, that the method proposed for this purpose would be the best; on the contrary, it seems very inferior to the mode of applying steam to salt pans, &c., for which Mr. James Smith, of Worcester, obtained a patent, about six months previous to the date of that of Mr. Parkes, the specification of which may be seen in Repertory, Vol. XLIV. p. 74, and we are also inclined to think that Mr. Smith's method of having a part of the pan for the salt to settle in, not acted on directly by the heated medium (by making its bottom project beyond the top of the steam vessel about 18 inches at every side), would be at least as effectual as the cylindrical vessel of the patentee, placed at the bottom of his boiler for the same purpose; and would be attended with less trouble, and less reduction of temperature of the brine, in removing the salt after its formation.

Perhaps in place of a figure, it may, in addition to the description, give a better idea of the shape of this patent boiler, to know that it bears a strong resemblance to an inflated air-balloon, with an upright cask fastened to its lower extremity.

Observations on the Re-building of London Bridge, with an examination of the Arch of Equilibrium, proposed by Dr. Hutton, and an investigation of a new method for forming an Arch of that description. *By* John Seaward, *Civil Engineer.* 8*vo.* 142 *pages.*

Mr. Seaward commences his work by an investigation of the most suitable curves for forming the arches of a bridge; where, in comparing the segment of a large circle, a semiellipse, a parabola, a hyperbola, and a catenaria, he gives the preference to the semiellipse, both on account of its "beauty," and because "no other curve can be so advantageously employed in forming the intrados of an arch. At the springing of an elliptic arch the curvature is considerable, and as it rises perpendicularly it affords the most commodious opening, both as a water-way and as a passage for craft."

Next to the form of the arch, the author thinks that nothing is of so much importance to the symmetry of the bridge as the situation of the points from whence it is to spring; and after comparing those of several bridges, asserts that in his opinion "no work of art can equal the beauty of a large arch, springing immediately from the surface of the water," and directs, on this principle, that in tide rivers, where the level of the water is continually varying, the springing of the arches should commence at low water mark.

The author next proceeds to examine Dr. Hutton's theorem for an arch of equilibrium, on which he makes the following remarks:—"This is the curve which the Doctor has so strongly recommended for the arches of a bridge, as being both of a graceful figure, and of a convenient form for the passage through it. I know not in what school the late venerable Doctor acquired his architectural taste, but with all due respect to his memory, I will venture to assert that the curve is any thing but graceful; it is, on the contrary, inelegant and unsightly, and is in every respect so ill adapted to form the arches of a magnificent bridge, that I am satisfied no architect or engineer, who

has any pretensions to taste or judgment, would risk his reputation by introducing it in any work of which he has the management."

The author, however, acknowledges his obligations to the Doctor for the principles on which he proceeds to construct "an arch of equilibrium, having a straight horizontal boundary line, with any curve for the intrados, and any required depth of voussoir," by which we presume the arch of the bridge to which this curve is to be applied is intended, as the arc of equilibrium can have but one line, and that certainly not a straight horizontal one. As an example, he calculates this curve for the arch of a bridge, in which the curve for the intrados was to be a semiellipse, and after several pages of algebra, ascertains one which will fall within the voussoirs of the arch, and which, passing through the bottom of the voussoir at the crown of the arch, will not be far from the line of intrados at the upper part of the arch, and will only depart from it at the lower parts, and that not to any great distance; while a curve parallel to it will correspond very nearly to the line of the extrados; by which means a solid arch of equilibrium will exist in the body of the voussoirs, having so much external to it, or superfluous, in the substance of the voussoirs, as will be necessary to shape their lower parts so as to form the semiellipse required for the intrados.

In forming the voussoirs for this arch, he directs that their sides should be perpendicular to the arch of equilibrium that passes through their substance, instead of to the semiellipse, which latter mode he justly objects to, as well as to some others which have been practised; and in the 7th chapter, where he treats of the depth of voussoirs, after carefully examining this essential matter, and determining that its ratio to the span is the best that can be applied to it, states that he is "convinced that one thirty-fifth part of the span is quite adequate for the voussoirs of a large bridge, in a crowded city."

In treating of the stability of arches, the author maintains

that this will depend on the mass of materials of which they consist; which may be modified, first, by increasing or decreasing the depth of the voussoirs, the weight remaining the same; secondly, by increasing or decreasing the weight, the depth of the voussoirs remaining the same; and thirdly, by increasing or decreasing the curvature of the arch, the other two particulars mentioned being the same. And to prove his position, that the stability of an arch is increased by diminishing the curvature, and thereby increasing the lateral pressure, he instances the cast iron arch over the river Wear, in Sunderland, and the centre arch of Southwark bridge, which have nearly the same span and depth of voussoir, but differ in the curvature and density; the former having a much greater curvature, and only about a third of the density or weight of materials; the consequence of which is, that the vibrations which occur in Southwark bridge are by no means considerable, while in Sunderland bridge they are what may be termed alarming oscillations.

On this subject, a little after the above remarks, the author states, that "the narrowness of the voussoirs of an arch of stone is of no consequence whatsoever, as regards its stability," which appears in direct opposition to part of his former assertions. He also observes, further on, that though an increase in the width of a bridge must be attended with a greater degree of stability, it does not follow that it would be prudent on that account to diminish the depth of the voussoir; as "it is to be presumed that over a wide bridge there will be much greater traffic, and consequently greater concussions than on a narrow bridge," a point which we can by no means allow; for, however the width of a bridge newly erected may have been determined by the expected traffic over it, when it is once formed it is quite plain that its width can have no influence whatsoever in this respect, unless it be so very narrow as to preclude the possibility of the whole of the traffic required passing over it, a case which we believe hardly ever occurred.

In the 8th chapter, on abutments and bearing piers, the chief novelty consists in the introduction of two series of notched or joggled stones in each abutment, extending quite across, and nearly in the line that the arch of equilibrium would form, if extended downwards from the upper and lower extremities of the voussoirs of the arch. Each of these joggled stones is to be prepared by cutting down a few inches of an oblong stone block, for about two thirds of its length, and thereby leaving the other third projecting; and when they are arranged as proposed, with each course lying before the projection of that beneath it, and thus assuming externally the appearance of a flight of stairs, they will be so connected that no one course can be protruded by the lateral pressure, without moving the whole mass altogether, with whatever masonry there might be erected in continuation behind it. The author, besides recommending this plan, objects to the method of radiating the courses of the abutments, by which we suppose is meant the sloping them obliquely upwards, which has been practised in some of our best bridges; but it appears that this method has not in these instances been attended with the inconveniencies which he supposes; and however we may incline to recommend his plan as good and sufficient, we are by no means convinced of the propriety of condemning the other method.

The calculation first mentioned by the author for the curve of equilibrium, was made for arches whose spandrels were to be filled up with solid masonry of the same density as the voussoirs. In the 4th chapter he gives another algebraical calculation, to determine that curve for arches with hollow spandrels, formed like those of Waterloo bridge, with eight parallel walls of bricks, 27 inches thick, covered with flat stones between the external walls, which were to be 6 feet thick, and for a bridge 53 feet broad from outside to outside, with elliptical intrados, and finds that the curve of equilibrium coincides still more nearly with the elliptical curve than that first calculated for the

arch with solid spandrels, and therefore concludes that the making the spandrels hollow is particularly advantageous, not only in saving materials, but in simplifying the curve of equilibrium, and bringing it nearer the curve mentioned, which makes it more suitable for the purposes of an arch.

In page 58 the author states, that though the curve of equilibrium, or of direction, has in the investigations been assumed to coincide with the lowest point of the voussoir, at the crown of the arch, this having been done only to facilitate the computation, is not to be considered as an indispensable condition, in investigating the arch of equilibrium; and that the curve might be described from any other point in the vertical line of that voussoir, as from its middle or from its highest point.

In the first figure of an arch with this curve (fig. 14), the author has represented it as forming the extrados of the voussoirs, a method which would much facilitate the construction, the intrados being in the line of the semiellipse of the arch; but in all the other figures which follow, he has shown it as falling a little within the extrados towards the sides; and in p. 61 he has given the method, by an algebraical computation, for forming this upper curve of the voussoirs, or line of the extrados, by determining successive points within its extent.

PROPOSED BRIDGE.

The bridge which Mr. Seaward proposed to be built on the foregoing principles, was to be built of only three arches, all semiellipses, of 230 feet span, and 48 feet altitude or rise, and to spring from the level of the lowest low water mark. The voussoirs were to be 6 feet 6 inches depth at the crown of the arch; the roadway was to be nearly horizontal, and the road materials were to be 4 feet 9 inches in depth above the extrados. The width of the roadway was to be 50 feet in the clear of the parapet walls, and allowing 3 feet for the thickness of the latter, the

whole breadth of the bridge, from one external face to the other, would be 53 feet. The spandrels of the bridge were to be made hollow, the roadway being supported (as in Waterloo-bridge) by eight parallel walls of brick-work, each three bricks thick; and the voussoirs, as well as the whole of the facing, was to be made of the densest granite, of 12¼ cubic feet to the ton.

The voussoirs were to be set quite dry, without any mortar or cement, and their joints, which intersected the great lines of pressure, were to be run with lead, after the masonry was set, which the author thinks would not cost above three or four thousand pounds more; and if contracted for by the builder, would induce him to take great care that the stones were well and accurately dressed, to save the expenditure of the lead.

The abutments were to be made 65 feet in length, and their height from the timber cradling over the piles, to the level of a horizontal line through the top of the voussoirs, was to be 70 feet, which would cause the cradling to be 21 feet below low-water mark, and they were to be secured by two lines of joggled stones continued from the upper and lower extremities of the lowest voussoirs to the timber cradling, as before mentioned.

The piers were to be 28 feet across, which is four feet more than those of Southwark-bridge, and eight feet wider than the piers of Waterloo-bridge. Their foundations were to be five feet lower than those of the abutments, and were to extend 14 feet beyond the face of the piers and cutwaters, which would make their areas about 105 feet long by 56 feet wide. After the coffer dam was formed in the usual manner, it was intended to drive a complete belt or inner dam of permanent cast-iron or sheet piling, exactly to the size and form of the required foundation; the sheet piles to reach 10 feet below the timber cradling, and 10 feet above; which would both secure the base from being undermined by sudden floods, and would

prevent the spreading of the strata beneath the foundation, while the piles were being driven down.

The fronts of the cutwaters were to be formed of two segments of cylinders meeting in the middle similar to a gothic arch, formed each with a radius of about three-fourths of the breadth of the piers; and each cutwater was to be surmounted by a colossal recumbent figure of a river god; and the elevated pedestals above the abutment piers were to be surmounted by groups of figures.

There were to be no stairs at the abutments, the author thinking them very unsightly; and that landing and plying places for watermen would be more conveniently placed at the ends of the adjoining lateral streets.

The cornice and balustrades are not described; but from some expressions of the author, we think he preferred those of the Doric order.

The scite of the bridge was to be exactly where the old bridge stands, and a new street at the Surrey side was to be made to it from the vicinity of the Bricklayer's Arms.

Archways were to be made between Upper and Lower Thames-street, and between Tooley-street and the Borough High-street; and the communication with these two latter streets and the bridge were to be formed by lateral roads made to join the new approaches.

In some considerations on the expence of a bridge, the author gives it as his opinion, that though, for reasons which he has stated, the doctrine of large arches being more economical than small arches, is not quite correct; yet that in certain circumstances this would happen; and thinks this would be the case with respect to his proposed bridge; because the increased expence of a bridge with large arches is principally confined to the voussoirs, the abutments, and the centring, while the saving lies in the coffer dams; and he computes, his method of forming the arches would admit the voussoirs to be of such a size, that they would require little more materials than a bridge

of five arches, in the same situation: and also proposes to employ the arches of the old bridge in making the centring for the new bridge, by which he asserts that the expence would be so reduced, as to be far less than what would be necessary for a bridge of five arches without this conveniency.

This work is very creditable to the author, shows that he understands his subject well, and is very competent to the construction of the fabric he proposes; which we have no doubt would have fully answered his expectations in stability and durability, had it been erected, and would have formed a magnificent ornament to the City, from the beauty and grandeur of its structure.

We cannot agree with him, however, that the property in Fish-street-hill and the adjoining streets would be little affected by his bridge, as it is evident, that by carrying the road over it horizontally as he proposed, a great part of Fish-street would be several feet below its level, and that consequently the value of the shops there and in the adjoining streets must suffer materially from this circumstance; as would also that of those in the Borough, which the elevation of the roadway would affect for a greater extent.

The bridge now erecting will not in any respect do this to so great a degree, on account of its terminating at a lower level, even after making all allowance for the changes caused by its being a little higher up the river than the old bridge; and supposing that a new street, as has been proposed, will be made from it to the Exchange, and another street from the Circus in Moorfields to join it, as a great advantage to the traffic of London, as well as a speculation likely to be profitable to its undertakers.

The remarks on Dr. Hutton's arch we think had better have been spared; the well earned fame of that celebrated mathematician stands on too firm a basis to be affected by

what is said, and his work on bridges will ever be an indispensable study for the accomplished architect. We think the author must have been mistaken in supposing that Dr. Hutton meant to recommend exclusively the arch of equilibrium, cited by him, for the structure of bridges, as the learned and accurate Dr. Thomas Young expressly states, in the 2d volume of his Natural Philosophy, p. 177, that "Dr. Hutton recommends an elliptic arch" for this purpose. Besides, we have reason to suppose that there is not so great a difference between Dr. Hutton's curve of equilibrium and that of our author, as he may imagine, for having applied to them both a catenaria (which is easily done by inverting the figures and placing them upright), we found that they both corresponded with that curve so exactly, as to induce us to believe, that if the catenary curve is not perfectly the same, it differs so little from them that it might be used in the same manner, to produce equally good effects in building; the only difference between them being, that to make the chain correspond with Dr. Hutton's curve, when inverted, it must be permitted to descend lower; and for that of the author's, be stretched more tight, so that the latter may be considered as the segment of a large catenarian curve near the top, and the former as a very large portion of a smaller one, and descending much lower. As to urging experiments as grounds of belief in such matters, we think it in general perfectly fair, and peculiarly so where the catenarian curve is concerned, which in fact is one decidedly of mechanical structure, however it may have employed mathematicians in investigating its useful properties; and we here beg leave to recommend to architects, the study of what Dr. Gregory published in 1697, to prove its being the best form for an arch; in discovering which, he seems to have understood its properties better than its inventor, Galileo; who mistook it for a parabola, or than Bernouilli and Leibnitz, who made its real nature first known.

As to the beauty of the forms of arches mentioned (a point on which the author claims a decided superiority, and thrusts down the Doctor somewhat roughly), we think it is so much a matter of taste and opinion, that on so important a subject as the structure of a large bridge, having a great traffic passing under as well as over it, utility should ever have the precedence. In which view we can by no means recommend arches springing from low water mark, so highly extolled by the author, as a considerable portion of them at each side would evidently be much in the way of the barges and other craft passing up and down; and to many eyes their beauty would not be so apparent as he supposes, since the idea of a flooded river, and an obstructed passage, must be always connected with their appearance.

Besides, if an arch, springing from an elevated erection, were to be reckoned a defect in beauty, from not coinciding in the line where they join, as the author seems to suppose, what are we to think of Grecian colonnades, where the entablature forms a right angle with its supports. Yet no one ever doubted the beauty of those elegant structures.

We agree, however, with the author, in reprobating the practice of sticking up pillars over the cutwaters by way of ornament. A pillar in its place no doubt has its beauty; but to put it up where it supports nothing, and at the top of a building instead of its lower part, which is its proper station, seems about as rational as it would be for a sculptor, in admiration of the symmetry of a human leg, to place a pair of them close beneath the chin of a statue, by way of improving on nature's work. We much fear, however, that the ornaments proposed by the author for those places, and for the tops of the abutment piers, would be inadmissible at present, while the police either want power or inclination to defend matters of this nature from the mutilation to which they would be exposed, from

the savage dispositions of the lower classes of our population, who delight in defacing what those of other nations protect as an honour to their country.

We will now conclude with observing, that though the author did not intend this as a complete treatise on bridge building, as stated in his last page, yet he has given so much useful information respecting it in a small compass, that the young architect, who will fully make himself master of it, will find his studies so materially assisted, that even if he extends them no farther, he will be no mean proficient in the art.

LIST OF NEW PATENTS.

George Henry Lyne, of John-street, Blackfriars Road, machinist and engineer, and Thomas Stainford, of the Grove, Great Guildford-street, Southwark, smith and engineer, for improvements in machinery for making bricks.—Dated August 23, 1825.—Six months to enrol specification.

William Parr, of Union Place, City Road, Middlesex, Gentleman, for an improvement or improvements in the mode of propelling vessels.—Dated August 27, 1825. Six months to enrol specification.

John Bowler, of Nelson-square, Blackfriars Road, Surrey, and Thomas Galon, of the Strand, Middlesex, hat manufacturers, for certain improvements in the construction or manufacture of hats.—Dated August 27, 1825.—Six months to enrol specification.

Charles Mercy, of Edward's Buildings, Stoke Newington, Middlesex, Gentleman, for improvements in propelling vessels.—Dated September 8, 1825.—Two months to enrol specification.

William Jefferies, of 46, London-street, Radcliffe Cross, Middlesex, brass manufacturer, for a machine for

impelling power without the aid of fire, water, or air.—Dated September 15, 1825.—Six months to enrol specification.

JEAN ANTOINE TEISSIER, of Tottenham Court Road, Middlesex, Gentleman, for improvements in steam engines. Communicated to him by a foreigner.—Dated September 15, 1825.—Six months to enrol specification.

CATHCART DEMPSTER, of Lawrence Pountney Hill, London, Gentleman, for improved cordage.—Dated September 15, 1825.—Six months to enrol specification.

GEORGE HOLWORTHY PALMER, of the Royal Mint, civil engineer, for a new arrangement of machinery for propelling vessels through the water, to be effected by steam or any other power.—Dated September 15, 1825.—Six months to enrol specification.

ADAM EVE, of South, Lincolnshire, carpet manufacturer, for improvements in manufacturing carpets, which he intends to denominate Prince's Patent Union Carpet. Communicated to him by a foreigner.—Dated September 15, 1825.—Six months to enrol specification.

ISAIAH LUKENS, late of Philadelphia, but now of Adam-street, Adelphi, Middlesex, machinist, for an instrument for destroying the stone in the bladder, without cutting, which he denominates Lithontrepton.—Dated September 15, 1825.—Six months to enrol specification.

SIR THOMAS COCHRANE, Knight, (commonly called Lord Cochrane), of Tunbridge Wells, Kent, for a new method of propelling ships, vessels, and boats at sea.—Dated September 15, 1825.—Six months to enrol specification.

CHARLES JACOMB, of Basinghall-street, wool broker, for improvements in the construction of furnaces, stoves, grates, and fire-places.—Dated September 15, 1825.—Six months to enrol specification.

THE

REPERTORY

OF

PATENT INVENTIONS, &c.

No. V. NOVEMBER, 1825.

Specification of the Patent granted to DAVID GORDON, *of Basinghall-street, London, Esq. for certain improvements in the construction of portable gas lamps, and which improvements are applicable to other apparatus for facilitating the use of compressed gas.* Dated April 14, 1824.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. *Now know ye,* that in compliance with the said proviso, I, the said David Gordon, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the drawings which are hereunto annexed, and by the following description thereof, (that is to say): My improvements in the construction of portable gas lamps relate particularly to the stop and regulating valves which are employed to retain the compressed gas within the reservoir of the lamps, during the process of filling the same; and also for the purpose of regulating the flow or escape of gas from the reservoir to the burner, in proportion as it is consumed. Fig. 1, (Pl. X.) upon the annexed drawing, represents an improved construction of regulating valve, adapted to permit the flow of gas to the burner, or to shut it off at pleasure. It is composed of two pieces

of metal, A and B, which are screwed together at *a a*, having a soft metal collar, *b b*, inserted in the joint for the purpose or rendering it tight. The said collar is composed of lead, soft solder, or other sufficiently soft metal, and is firmly fixed by soldering, or otherwise, to one of the surfaces which form the joint: it is not, therefore, in danger of being displaced or injured by screwing it up tight, but produces a very tight and sound joint. The lower part of the piece, B, is adapted to screw into an aperture at one end of the reservoir of the lamp, and when the regulating steel screw, *c*, is screwed down so that its conical point enters the conical cavity formed in the piece, B, it closes like a valve, and prevents all escape of gas to the burner; but on turning the regulating steel screw slightly round by its square head, the gas may be allowed to escape through the passages, *e e e e*, to the burner, *f*, in any degree that may be desired. Previously to inserting the regulating screw, *c*, in its place, I dip it in a mixture of bees-wax and oil, which operates to fill up the threads of the screw, and thereby effectually prevents the escape of gas by its sides during the time that the lamp is burning. This form of regulating valve is found to admit of great delicacy of adjustment, and is not liable to get out of order in the course of use. The lower extremity of the regulating screw, where it fits into the metal socket, may be formed to a straight cone, as shown in the figure; or it may be shaped to a sphere or other suitable figure, and in some cases a conical or tapering screw might be employed to form the fitting part. Fig. 2 shows an improved construction of valve, to be used in filling the reservoirs of portable gas lamps. It is intended to be screwed into the opposite end of the reservoir to that which is occupied by the burner and regulating valve above described. This filling valve consists of a small conical plug of metal, leather, or other convenient and suitable substance, marked *g*, which is fitted into a conical cavity or seat in the piece of metal, C, similar to the valve of an air gun, being closed

by a slight steel spring, *h*, and guided in its seat by a metal pin, which slides through a hole in a small brass cap or perforated cover, *i*, which is represented as screwed over it: D shows a brass plug, which is intended to be screwed into the lower aperture of the piece, C, after the filling is completed. The upper surface of this screw plug is furnished with a soft metal ring or collar, *b b*, (as above-mentioned) which being pressed by the force of the screw into close contact with the underside of the piece, C, effectually prevents any escape of gas from that end of the reservoir, even if the filling valve, *g*, should not be quite air-tight. Fig. 3 shows an improved construction of regulating valve for the emission of gas, which possesses the advantage of great simplicity, and at the same time is capable of much nicety in adjusting the flow of gas to the burner. In this construction the passages, *e e*, for the gas, are drilled out of one solid piece of metal, and the regulating steel screw, *c*, is tapped into the side of the same piece, in such a manner that its conical point may be caused to open or close up the passage at pleasure, and thus regulate the emission of gas at the burner, *f*. The construction of this regulating valve will appear evident from inspection of the figure, without entering into a more detailed description thereof. Fig. 4 shows another modification of the regulating valve, the chief difference being in the position of the regulating steel screw, *c*, which in this latter construction is placed in a vertical position, with its conical point adapted to close the conical aperture of the passage, *e*, and thereby impede or regulate the flow of gas to the burner, *f*. Note, either of the last described regulating valves may be employed in combination with the improved filling valve described, by reference to fig. 2. Fig. 5 represents an improved construction of stop valve, which is particularly adapted to the transferring of compressed gas from one lamp or reservoir to another, without occasioning loss during such process. It is composed of two pieces of metal, A and B, which are screwed together

with a soft metal collar between them, at *a a* : *e e* represents the openings through which the gas is allowed to pass. The piece, A, has the regulating steel screw, *c*, tapped through it, being formed at the lower part with a double cone, one part of which cone is adapted to fit into a conical cavity or seat in the piece, B, and the other cone is adapted to fit correctly into the cavity in the underside of the piece, A. Now when the lower cone of the regulating steel screw is screwed or forced tight down into the conical seat in the piece, B, it prevents all escape of gas; and when it is desired to transfer compressed gas from one lamp or reservoir to another, the regulating screw, *c*, is to be turned until its upper cone fits and applies correctly into the conical cavity in the piece, A, and thereby prevents all escape of gas up the threads of the regulating screw during the process of transferring, allowing at the same time free passage for the gas from one reservoir to another, through the openings, *e e*. Fig. 6 shows another construction of stop valve for effecting the same object, (viz.) the transferring of compressed gas from one reservoir to another. It is composed of two pieces, A and B, screwed together with a soft metal collar between them, similar to the one last described; but the regulating steel screw, *c*, instead of being formed with double cones, is furnished at the extremity with a loose button or revolving cylinder, *d*, having soft metal collars, *a a*, *b b*, soldered upon the upper and under surfaces thereof, so that the underside of the said button or cylinder may be screwed down tight upon the lower passage, *e*, and thereby effectually stop the flow of gas; or by turning the regulating screw the contrary way, the upper side of the said button may be screwed up tight against the underside of the piece, A, as represented in the figure, and thus prevent the escape of gas by the threads of the screw, during the period that gas is flowing through the passages, *e e*. These valves are found to be particularly useful for many purposes connected with the filling of portable gas lamps,

and are less liable to get out of order than any stop cocks which I have hitherto met with. I have now described my invention of improvements in the construction of portable gas lamps, with reference to the annexed drawing, in such manner as to enable persons conversant with works of a similar nature to practise the invention; and I hereby declare that I confine my claim of invention to the following particulars, (viz.) First, to the employment of separate and distinct valves for the entrance and exit of gas to and from the reservoir of portable gas lamps, such separate valves being constructed and combined in the manner hereinbefore described, with reference to figs. 1, 2, 3, and 4, upon the annexed drawing. Secondly, to the improved construction of the stop valves to be employed in transferring compressed gas from one lamp or reservoir to another, being provided with a double cone, or with flat surfaces furnished with soft metal, or other suitable collars, to prevent the escape of gas up the threads of the regulating screw, as above described, with reference to figs. 5 and 6 upon the drawing. I also claim the use of soft metal rings or collars, as a means of making joints tight in apparatus connected with portable gas lamps; such rings or collars being soldered, or otherwise fixed against one of the surfaces of the joint, and pressed into contact with the hard metal surface on the other side sufficiently to prevent the escape of gas without employing leather, or other similar pliable material or substance. It is to be remarked, that the figures upon the drawing are about the real size of the apparatus;* but the forms and proportions may be varied according to the circumstances of the case, as well as the materials of which the same may be formed or constructed, and without departing from the object of the invention, as hereinbefore described and set forth.

In witness whereof, &c.

* In the engraving the figures have been reduced one half.

Specification of the Patent granted to JOHN MASTERMAN, *of No.* 68, *Old Broad-street, London, Gentleman, for an improved method of corking bottles.* Dated March 5, 1825.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is described and ascertained by the drawings in the margin hereof, and by the explanation thereof, and by the descriptions and observations hereinafter contained, that is to say :—My method of corking bottles is by introducing, either by pressure or impulse, the cork into the neck of the bottle, through a conical tube, having its smaller orifice in direct and immediate communication with the mouth of the bottle, so that the tube and the neck of the bottle may form, in effect, one continuous tube: such conical tube having its smaller orifice of such a size with respect to the cork to be passed through it, as that the sides of the cork must be compressed in passing through it, or, at least, must be in such close contact with the inside of the tube, as to be prevented from bulging out, or expanding laterally, while the lower end of the cork is entering the smallest part of the neck of the bottle. But I prefer and use the tube with the same orifice, so small, that the cork must be considerably compressed in passing through it. The length of the tube need not much exceed the length of common corks; its upper or larger orifice ought to be sufficiently large to admit, very easily, the end of the cork to the middle of the tube. Machines by which the corks may be forced through the conical tubes into the bottles, according to my said method of corking bottles, admit of such a variety of constructions, that were I to describe any one machine in particular, proper for this purpose, and claim the

whole of that one alone, as constituting my said invention, the said letters patent might probably be evaded by modifications of several of the parts of that one machine: therefore, the only part of any machine for corking bottles, according to my said method, which I claim as my said invention, is the conical tube, or conical tubes therein, through which the corks are to be forced into the bottles, according to my said method. But I declare that the constructing, selling, using, or exercising, of any machine, of whatever construction, for corking bottles according to my said method, will be an infringement of the said letters patent, provided that the conical tube or tubes, as before described, and to be applied in the manner before-mentioned, enter into the construction of any such machine.

I now proceed to describe a machine for corking the ordinary quart bottles, according to my said method; in which machine the conical tubes, and the mechanism for forcing the corks through them into the bottles, are arranged in that manner which I consider the best adapted for carrying my said method into execution.

Figure 7, (Pl. X.) is the front view of the machine. Figure 8 is the side view thereof. Each figure is drawn to a scale of three inches to a foot.* The letters refer to the corresponding parts in each figure: *a* is a frame: the two sides are connected by the cross piece, *b*. Two cylindrical pillars of iron, *c c*, of similar dimensions, are fixed into the cross piece, *b*, parallel with each other; their tops are connected by the bridging piece, *d*: *e* is a four-sided bar of iron, which traverses upon the upper parts of the said pillars, at right angles with them, by means of a hole towards each end, through which *c c* pass. Each end of *e* projects beyond *c*, and terminates in the form of a gudgeon: *f f f* are what I term "the impellers;" they pass through and are fixed in the bar, *e*; their upper ends traverse through three holes in the cross piece, *d*, for the purpose of maintaining them parallel with each other: *g* is firmly

* The figures in the engraving have been reduced one third.

fixed to *c c*, and *a a*, at such a distance from the top of the pillars, *c c*, that when *e* is raised close to the cross piece, *d*, there may be a space between the bottoms of the impellers, and the top of *g*, at least equal to the length of a cork. In *g* are fitted or formed, three conical metal tubes, (represented by the dotted lines); they are so placed with respect to the "impellers," as to have common centres or axes with them respectively. The largest tube has its top larger, and its bottom smaller, than the largest sized cork required. The smallest tube has the same relation to the smallest sized cork required; and the middle tube is a medium size between the two others. Three different sized tubes are sufficient for quart bottles, whether for wine or beer. The bottoms of the "impellers" are smaller than the lower orifices of their respective tubes: *i i*, are two levers, of equal dimensions, which work on the gudgeons at the ends of *e*. These levers are firmly secured, parallel with each other by cross metal rods, *h h*, connecting the corresponding ends of each. Thus these levers and connecting rods form, in effect, and will be referred to, as one lever: *k k* are two side rods; their lower ends work on two pins, fixed in the sides of the frame, *a*, at corresponding points; their upper ends work over the ends of the cross rod that connects the shorter arms of the lever, and which ends are made to project for that purpose: *l* is a trough, which is elevated or depressed by a wedge, *m*, acting between it and *b*.

The machine, as above described, is ready for being worked.

Place a bottle so that its mouth may be under, and in contact with, that tube which is of the proper size for introducing the cork into it. I prefer that the end of the tube should be a little within the mouth of the bottle. Retain the bottle in this position by elevating the trough up to the bottom of the bottle by means of the said wedge. Then raise the impellers, by means of the lever, and put a proper sized cork into that tube in contact with the bottle;

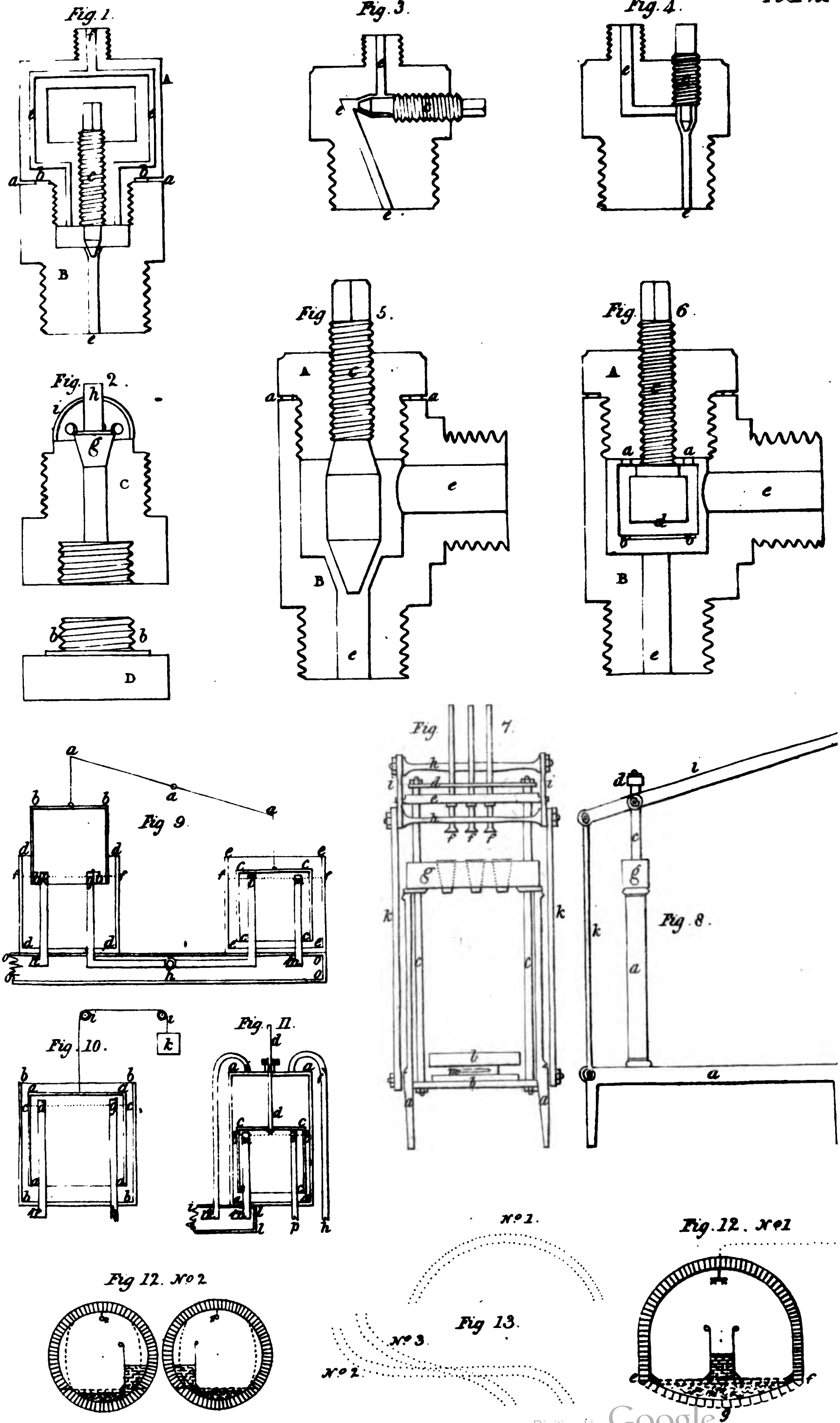


Fig. 1.
Fig. 3.
Fig. 4.
Fig. 2.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12. No 2
No 1.
Fig. 13.
No 3.
No 2.
Fig. 12. No 1

then depress the lever; by which means the impeller will force the cork into the neck of the bottle. The bottle and trough are then lowered by withdrawing the wedge. The bottle is then removed, and the machine is thus ready for corking another.

By my said method of corking bottles it is evident, that common corks may be used, which (if preferred) may be introduced with the larger end downwards; that cylindrical corks may be used; that, as the corks may be introduced so far as that their heads may be within, or lower than, the top of the mouth of the bottle, shorter corks may be used, and be as efficient as the common ones; that a bottle may be corked with a larger cork than by the common method; that the time lost in biting the corks, or in crushing their ends by other means is gained; that there exists little or no risk of breaking a bottle in corking; the result of all which is, that bottles may be corked both in a better manner, and at a cheaper rate, by my said method, than by that now in use.

In witness whereof, &c.

Specification of the Patent granted to SIMEON BROADMEADOW, *of Abergavenny, Monmouthshire, Civil Engineer, for an apparatus for exhausting, condensing, or propelling air, smoke, gas, or other aëriform products.* Dated April 2, 1825.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. &c *Now know ye,* that in compliance with the said proviso, I, the said Simeon Broadmeadow, do hereby declare that the nature of my said invention, hereinafter described, does not in any way whatsoever interfere with a Patent already granted to me, bearing date 19 January, 1824; but that the manner in which the present invention is to be per-

formed is particularly described and ascertained as follows, (that is to say:)—In the drawings hereto annexed are represented various views and sections of my apparatus for exhausting, condensing, or propelling air, smoke, gas, or other aëriform products as aforesaid, reference being thereto had, and to the figures and letters marked thereon, as follows, (that is to say:)—My invention consists in particular arrangement of mechanism, hereafter to be described, for the purpose of exhausting or withdrawing the air, smoke, gas, or other aëriform products, generated either in the process of distillation, and thereby withdrawing the pressure from the interior of the apparatus to any flue or chimney connected with the furnace or fire-place, thereby producing the necessary draught or current of air requisite to the combustion of the fuel, and at the same time propelling the same after it has been converted to smoke or other elastic fluid, either through flues under ground, or in any way disposing of the same as may be found most convenient. This action is performed by one or more inverted vessels working in water, or any other suitable liquid, according to the gas, air, or smoke to be operated on, which will be more fully described and ascertained by reference to the drawing hereto annexed. Fig. 9, (Pl. X.) represents a sectional elevation of an apparatus where two inverted vessels are acted on by the alternate motion of a lever, from which they are suspended at equal distances from the fulcrum thereof: *a a* is the lever from which the vessels are suspended, which moves on the fulcrum at *a*, and has an alternating motion imparted to it by a steam-engine, or other adequate first mover: *b b b b*, and *c c c c*, are the two inverted vessels before-mentioned, which are perfectly air-tight, except being open at the lower extremity: *d d d d*, and *e e e e*, are the larger vessels or tanks, fitted to the line, *f f*, with water or other liquid, in which the inverted vessels, *b b b b*, and *c c c c*, respectively ascend and descend by the action imparted from the lever *a a*, as before described: *g*, *h*, *i*, is a tube or pipe, passing

through the bottom or other convenient part of the vessels, *dddd*, and *eeee*, and reaching above the surface of the water line, *ff*: at the extremities, *g* and *i*, are placed valves, opening respectively towards the interior of the vessels, *bbbb*, and *cccc*, and at *h*, connected with the flue or furnace, where the action or operation of exhausting is purposed to be applied: *kl*, and *mn*, are separate pipes, passing through the bottom or other part of the vessels, *dddd*, and *eeee*, and also reaching a little above the surface or water line, *ff*. These pipes or tubes open or lead in the larger tube or trunk, *cccc*, and have valves placed at the extremities, *l* and *n*, opening towards the interior of the trunk or tube, *oooo*, which is led in the most convenient direction, as circumstances may require. To put this arrangement of my apparatus in action, it is requisite to impart motion to the lever, *aa*, as before described, which raising and depressing the inverted vessels, *bbbb*, and *cccc*, the air, smoke, gas, or other aëriform products, are drawn or exhausted during the ascent through the tube, *ghi*, from the furnace, and on the alternate descent of each inverted vessel, propelled or driven forward through the tubes, *kl*, and *mn*, into the trunk, *oooo*; the valves at *g* and *i* opening during the ascent of the inverted vessels aforesaid, and closing during the descent; and the exit or outlet valves, at *l* and *m*, opening during the descent of the inverted vessels aforesaid, and closing during their ascent respectively, thereby causing a regular draft or exhaustation to take place at the point, *h*, and a continuous blast or current of air, or other elastic fluid, to flow from and into the trunk, *oooo*. Fig. 10 represents a sectional elevation of an arrangement of my apparatus for exhausting or propelling air, smoke, gas, or other aëriform products, which I recommend in situations where power is not available, as a first mover, or where the process is of a slow and regular nature. It consists in suspending an inverted vessel by a chain or rope, either passing over pullies, or connected with a lever, so that a counter balance

or weight, rather exceeding the weight of the vessel, may at all times during the operation of exhaustation act as a power to raise the inverted vessel, and produce the effect as before described: *a a a a* is the inverted vessel: *b b b b* is the tank, containing water or other liquid, to the line, *c c*. The outlet pipe is shown at *d f*, having a valve at *f*; and the inlet pipe at *g h*, having a valve at *g*: *i i* are pullies, over which a chain or rope passes to suspend the vessel, *a a a a*, and at the other end connected with the counter balance or weight, which exceeding the weight of the inverted vessel, has a constant tendency to draw up the same, and thereby produce the effect of exhaustion, as before described. In this arrangement, when the inverted vessel is full of air, gas, or other elastic fluid, the weight, *k*, must be diminished, and the pressure of the vessel itself will propel or drive forward the air or other product contained therein, by the outlet, *d f*; the valves at *g* and *f* reversing their action, as before described in fig. 9. Fig. 11 represents a sectional elevation of another arrangement of machinery, where a single inverted vessel effects a continuous tendency to exhaustion, and propels the air, gas, or other elastic vapour, as before described: *a a a a*, is a vessel completely closed and filled to the line, *b b*, with water, or other suitable liquid: *c c c c*, is an inverted vessel, suspended by the rod, *d d*, passing through a stuffing box or collar of leather, at the point, *e*, by which rod the aforesaid vessel is alternately raised and lowered, as before described, by any adequate power or first mover: *f h* is an inlet pipe, having a valve at *f*, opening towards the interior of the vessel, *a a a a*: and *i k* is an outlet pipe, with a valve at *k*, opening towards the interior of the trunk, *l l l l*, which leads the air or gas to its destination: *m n* is the outlet pipe to the interior of the inverted vessel, as before described; and *o p* the inlet pipe, having severally the same arrangement of valves as in fig. 9. By this arrangement a partial vacuum is formed by the alternating motion, imparted by the rod, *d d*, both in the inside of the

vessel, *c c c c*, and in the upper part of the closed vessel, *a a a a*, thereby causing a continuous exhaustion or tendency towards vacuum in the pipes or tubes thereto connected, and leading to the furnace as before described; and also propelling the air, smoke, gas, or other aëriform product therefrom, extracted by the outlet pipes, *i k*, and *m m n*, into the trunk, *l l l l*, and thence through any arrangements of the manufacture to which the principle is applied. Having now described, with reference to the annexed drawing, my invention of an apparatus for exhausting, condensing, or propelling air, smoke, gas, or other aëriform products, I do hereby declare that I confine my claims of invention not only to the several arrangements of my apparatus, as hereinbefore described, but to the application of the principle of exhaustion caused by mechanism raising a vessel inverted in water, or other suitable liquid. The form, proportion, and also the material of which the vessels, tubes, and other parts of the apparatus are to be constructed, must depend on the nature and amount of air, gas, smoke, or other aëriform product, to be operated on governed by circumstances, without in any way departing from the object of my invention, as hereinbefore described and set forth.

In witness whereof, &c.

Specification of the Patent granted to LOUIS LAMBERT, *of* 29, *Cannon-street, London, Gentleman, for certain improvements in the material and manufacture of paper.* Dated November 23, 1824.

TO all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said Louis Lambert, do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in the manner following, (that is to say:)—My said secret or invention consists in the employment of straw,

which I prefer to free from knots by cutting them off the stems. I next submit the straw to ebullition with quick-lime in water, in the proportion of four ounces of lime to one of water, to extract the colouring matters, and to dispose it to become fibrous. I can also employ, for the same purpose, caustic potash, soda, or ammonia. It is then washed. I next expose it to the action of a hydro-sulphuret, composed of quick-lime and sulphur, in solution, in the proportions of four ounces of lime to one of sulphur, with one quart of water, in order to free it from the mucilaginous and silicious matters, so prejudicial in paper-making. I then wash it thoroughly in successive portions of water, by exposing it to the action of the paper mill, till all smell of the alkaline sulphuret is entirely removed. I then press it, and afterwards submit it to the usual operations employed in bleaching vegetable fibres, viz. to the action of chlorine, either separate, or in combination with lime, or by exposure to the open air and light upon the grass. After this it is well washed, till all the smell of bleaching is withdrawn; and lastly, it is exposed to the action of rag-engines, usually used in paper-making, in order to reduce it into pulp or paste, previous to being made into paper.

In witness whereof, &c.

Method of constructing a Tunnel of cast-iron Plates, with Flanches, placed by means of large iron Diving Bells. By MINBUR.

WITH AN ENGRAVING.

Abstracted from the Papers and Documents of the "THAMES ARCHWAY COMPANY."

IN projecting a tunnel under the Thames, at the part of the river proposed by the "Thames Archway Company," the first thing that falls under consideration is the information acquired, and the relative position in consequence.

The shaft and driftway have afforded information, that under this part of the river, to the depth of 13 or 14 fathoms, there are only to be met with alluvial beds (for none of those cut through deserve the designation of strata), intermixed with insulated concreted calcareous masses. The drift hath also further shown, that a large proportion of these beds, upon the North side, are quick, or moving sands.

The conclusion therefore must be, that the construction of a tunnel of magnitude, in the region of the driftway, if not an impossible case, may at least be judged impracticable with advantage, and therefore ineligible.

Experience hath shown, that of all the operations in mining, cutting mines in beds of subterranean mud, or quicksand, is perhaps the most difficult; and when completed, also the most difficult to keep in repair. The unequal pressure to which they are always subject, from a thousand circumstances,—from the very drainage itself, twist and warp mines cut through them in such a manner, as often, in spite of every exertion, to make them rush into ruin.

There remains, therefore, two positions, more eligible than that of the driftway, namely, either to run along the bed of the river, or to go under the driftway and the alluvial beds altogether.

In the execution of the first of these plans, a very powerful agent presents itself in opposition. The fixed law, *that fluids press equally in all directions,* would operate here with full force. This law, which is no other than the power of gravity, regulates equally the action of solids, when placed in a state of fluidity, as quicksands are; and their pressure becomes so much the greater as the specific gravity of the composed moving mass increases. Hence, in applying coffer dams, unless the piles can be driven into firm ground (an expectation the driftway does not encourage), a constant succession of materials will be thrown up within, by the pressure without, till the circumjacent bed of the river be flattened to a great distance,

and till many times the bulk of the tunnel be removed; an expence which no calculation whatever can possibly assign.

Admitting, however, that difficulty to be surmountable, another presents itself of no small magnitude, and which will render mason work of no safety, and hence of no use, in constructing this plan. Great precision would be necessary, in forming the tube of the tunnel, to render its weight equal to that of its bulk of the materials in which it is to be embedded, otherwise it will tend to place itself *in equilibrio*. If lighter, it will rise; if heavier, it will sink; and if the equilibrium of the quicksands shall at any time be disturbed laterally, it will be pressed accordingly. A frost in the river, or a stormy tide, removing or adding to a bank, may produce an effect of this kind. In all these cases mason work must be fragile, must be rent, and become useless. As, therefore, no human skill can pretend to fix a point against the effect of such powerful causes, it is plain the tube of the tunnel, upon this plan, must be formed of materials both cohesive and elastic. Cast-iron plates naturally present themselves as a substitute. These, properly proportioned, constructed with flanges turned inwards, and screwed together with bolts, would bear a considerable degree of shifting, and afford more safety; but at the same time, are not altogether without risk from more than ordinary pressure. To fix these plates in their places, I would also recommend a much shorter, easier, less expensive, and more practicable mode, than by coffer dams. I would recommend the use of capacious diving bells. These I would construct of cast-iron plates also; fit them up with convenient passages for the workmen to pass out and in, and for the delivery of materials; and fit them also with metallic pipes, through which an abundant supply of air could be thrown for any number of workmen, by the power of a steam-engine. Two bells could be used, commencing in the middle of the river, and working outwards. Coffer dams might be used above low water mark; and hence the work would advance at

four points at once. Of all the modes of executing this plan of the tunnel, I am satisfied the diving bell is by far the cheapest, most expeditious, and most practicable. Let the novelty of the proposition be no bar to its consideration, for I shall be ready to engage, in this manner, to perform any kind of work under water, and at any depth, with the greatest facility and safety. The project should recommend itself: it is not inconsistent with the adventures of an Archway Company. The bell is indeed not exempted from all the evils of the external pressure, described above: but they are not increased. They are diminished in proportion to the altitude of the water from the bottom of the bell to the surface, and consequently rendered much more manageable.

An advantage attending a cast-iron tunnel would be, that the whole drainage might only be leakage, which could be drawn from the tunnel itself without a separate mine, without much inconvenience.

A drawback, however, upon the above plan is, that it is deprived of that certainty, stability, and durability, which in great undertakings afford a high satisfaction to the mind, in contemplating the benefits to result to mankind and to posterity. The iron is a perishing article: accident alone may render its duration very short; and difficulties of repairing or renewing might arise to render the scheme altogether abortive. The Company, as a corporate body, should look to something more lasting. I would therefore seriously recommend to their consideration the other scheme of sinking, under the alluvial beds, into the solid stratification; or at least into such materials as are sufficiently solid, and not under the influence of the laws of fluidity, further than the water flowing from them.

In the accomplishment of this scheme, there must be neither dread nor fear of water; but proper provision must be made for drawing it. The plan of operations I would recommend as follows:—To put down the bore in the

bottom of the present pit, till the solid beds or ground be ascertained; then, as the result shall recommend, to put down the pit next the river on the South side, to the necessary depth. There is no occasion to go so far from the river as the other pit at the same side of the river. In this plan the depth is taken at about 25 or 26 fathoms. From the bottom of this pit I would recommend to cut a driftway or level to the middle of the river; or, perhaps, the whole breadth. This driftway would require to be large, 7 or 8 feet high, as it must be divided into two or three divisions. The first, in the roof, for the conveyance of air; the second for a waggon way; and the third for a reservoir, lest the engine should stand at any time; or the second and third divisions might form a canal, whilst the work is carrying forward, and supersede the waggon way. The whole will afterwards serve as a reservoir, to prevent interruption in the tunnel from water; and the larger the better, to hold a number of days' supply, to allow proper time for occasional repairs upon the engines. The great work would commence at the middle, and proceed outwards to both sides. The declination would be adjusted by the depth, and which could be afforded abundantly gentle at that represented. Indeed, at any depth it could be rendered gentle, by giving a curvature, such as represented by the dotted lines, fig. 13, No. 1, 2, and 3, (Pl. X.)

Either one or two parallel arches could be constructed, as represented in the transverse sections, fig. 12, No. 1 and 2, which is the construction I would prefer when practicable. Indeed it is always more practicable than two, unless removed to a distance from one another; and in most cases should be cut at a smaller expence. The footway, elevated above, and dividing the carriage roads, may either stop at the shafts, next the river, at each side, which will be converted into staircases, or they may proceed to the end; or both. The dimensions delineated are sufficient for ordinary carriages; if larger should be wanted, the dimensions may be

increased. In the section the tunnel is represented as passing in the solid strata till clear of the river. This may be necessary so far, or may not, according to circumstances. The stratification, dip and rise, are assumed merely for illustration, and meant to represent firm ground. I do not so much as know whether it is a stratified country. In parts where the ground is hard and solid, the bottom may be cut flat, as the line *ef*, in the section, fig. 12, No. 1; but where not sufficiently firm, would require a flat inverted arch, *efg*, to prevent heaving or letting down The plan of lighting is by the hydrogen gas, thorugh a tube and cocks. Lamps could be placed in the same situation

The returning of the ends, expressed upon the plan of the Company, implies a confinement upon the surface, which may produce inconvenience. This may be obviated by the curvatures, fig. 13, as much latitude may be taken under the river; but of this a correct opinion could only be given upon an inspection of the grounds.

The advantages of easier ascent and shortness, recommended by the Company, are not qualities of this plan. But if in making roads upon the surface, these qualities are often obliged to be dispensed with, there must be much less latitude in making roads below rivers; and other advantages are acquired for outbalancing those given up. Upon this plan alone complete mason work can be accomplished, and the undertaking rendered as lasting as the pyramids of Egypt. It is in this way alone that it can be handed down with benefit to posterity.

I have accordingly neither considered increase of ascent nor of length as forcible objections; but increase of depth must undoubtedly produce increase of water, and consequently increase of expence of drawing it; and it is here where the objection lies. If the feeders now require 14 horses' power, they may at least be expected to increase to double or treble that number. To obviate this objection, I would suggest different schemes. In the first place, as I am satisfied I could draw water much cheaper

than the Company, I would engage to go the depth of 30 fathoms, or more, at an expence little more than 20 horses' power, and would contract for a long period of years. This, however, is to be determined upon further information.

In the next place, the water drawn has a chance to be good fresh water, at least that from the gravel bank will. This, in such a situation, should not be thrown away; and the Archway Company might become also a Water Company, and then an ample flow would not be dreaded, but courted. For this purpose I would also contract, at a very moderate rate, to raise the water to any given height.

In cutting the tunnel in solid ground, there is also a chance of meeting with good stone, which would bring some value; and if a quarry where met with, I should show the Company how to work it with advantage. I shall not enlarge further, but remain your's,

UN MINEUR.

P. S. I have not added estimates to these plans, as more information would be necessary for the first, and even then might run the risk of being very fallacious. For the second, sufficient data are not yet given; but when given, might be estimated very minutely. I would recommend to the Company to fix upon their plan, and then take estimates; otherwise they may find estimates of very little use.

MINEUR.

On the Application of the Sliding-rule to facilitate Calculations of the strength of Materials. By A CORRESPONDENT.

Communicated by the Author.

IT does not appear to be very generally known, that the common sliding-rule can be applied to form a table of the breadths and depths of a series of beams of equal strength; and as the operation of setting the rule for this purpose

is very simple, perhaps you will have the goodness to place it before your readers.

The common sliding-rule has four lines of numbers, marked A, B, C, D. To prepare for the operation, invert the slider so the line B is next the line D. Then let the given beam be 2 inches in breadth, and 8 inches in depth. Set 8 on D to 2 on B, and the line B will show the breadths, and opposite each breadth on B, the corresponding depth will be found on D, so that the beam may be of equal strength.

Also, supposing it to have been found by calculation that the breadth, multiplied into the square of the depth, should be a known number, as 125, then set 125 on B to 1 on D, and the lines B and D become a table of breadths and depths. When the depth is the same as the breadth, the number is the cube root of 125, or of the number set to unity on D: in this case it is 5.

By means of Mr. Bevan's sliding-rule, a table of breadths and depths for beams or bars, of equal stiffness, may be exhibited. Thus, insert the slider E, inverted, between the lines A and D, and E becomes a line of breadths, and D a line of depths for beams of equal stiffness. If it be desired to know the breadth of a beam 10 inches deep, so that it shall be equally as stiff as a beam 8 inches square, set 8 on E to 8 on D, and opposite 10 on D, we have 4·1 on E, which is the breadth required.

When the number on E is equal to the opposite one on D, the number is the fourth root of the number on E, which is opposite to 1 on D. Hence we have a means of knowing the fourth root of any number at once, by inspection.

The sliding-rule is already a most useful pocket companion for those who have intricate calculations to make, when there is neither time nor opportunity to refer to tables; and if these few hints add any thing to its utility, it will afford considerable pleasure to your most obedient,

T. ——

On the construction of Carriage-way Pavements. By MR. BRYAN DONKIN, *Civil Engineer.*

A Paper read before the Institution of Civil Engineers.

COMMUNICATED BY THE AUTHOR.

THE very short period during which the pavements of this great metropolis remain in a tolerable state of repair, must have attracted the attention of all whom business or pleasure induces to traverse its streets in carriages or on horseback. The holes and inequalities with which every thoroughfare is filled almost immediately after it has been paved anew, whilst they occasion intolerable jolting, destroy carriages prematurely, and, by making the footing for horses very insecure, render two-wheeled vehicles and horseback extremely dangerous.

All are ready enough to detect the immediate cause of the speedy derangement of our pavements, in the immense number of heavy waggons, carts, and drays, which constantly crowd the principal streets; few, however, think of looking for causes more remote, which are within the reach of remedy, and which especially deserve attention, as mainly allowing the immediate cause to exert its destructive influence. The subject of pavement, however, is too important to have escaped the notice of engineers entirely. It has been investigated by some, and various improvements in the method of paving have been proposed; but from objections taken either to the nature of materials used, or the expence to be incurred, none of them has ever been generally adopted.

As the merits of the method of constructing carriage-way pavements I shall propose, will be best appreciated after the causes which render the plan usually pursued inefficient have been made known, I shall here explain these briefly.

In most of our streets the pavement lies on a soft and yielding bed; in several I have seen it bedded upon the

vegetable earth, or natural soil of the place; and in others, where it has required to be raised to the original level from which it had gradually sunk, I have seen it laid upon sand. This last, however, is generally employed in too small quantity to be of any use; for sand, though certainly a convenient material for bedding, and supplying a more durable support than earth, is still very far from what is requisite; indeed, is altogether useless, if sparingly employed.

Again, paving-stones of very irregular shapes, and of all dimensions, are generally laid indiscriminately together.

1. Varying universally in depth, the surface upon which they are to be laid must necessarily be prepared either by digging out or adding a quantity of earth, as a large or a small stone happens to be taken up by the paver. The very nature of this operation opposes the practicability of giving an equal support to every stone, or by any subsequent ramming of effecting this, if regard be paid to uniformity of surface.

2. It is a very common practice to lay a pavement without any attention to the relative size of the stones; two stones, however widely their areas differ, are frequently placed side by side. Now, the small stones opposing less resistance to a passing weight than the large, are soonest, as they are most easily, driven down, and the surface of the pavement is thus rendered uneven.

But supposing, for argument sake, that the earth upon which a pavement is laid has been previously well rammed when dry, the stones selected of one size, and carefully bedded (which would undoubtedly make a better pavement than is generally seen), this is not yet enough; for the earth being spongy and absorbent is softened in wet weather, and no longer yields a firm bearing to the stones; these, constantly exposed to heavy weights and to blows from carriage-wheels, are put into motion and churn, or pound the soil beneath, till it becomes a pulpy, semifluid mass, easily displaced laterally, *i. e.* from the under sur-

face of one stone to that of another, or upwards through the crevices between the stones into the street. One stone thus acts as a forcing-pump; for being depressed itself, the mud is either driven from below it laterally under the neighbouring stones, by which they are raised, or it is forced up through the crevices to the surface of the pavement.

Thus it is that the pavement so soon becomes uneven and full of holes, and at the same time covered with mud, to the great annoyance of passengers generally. Few are aware of the source whence the vast quantities of mud are derived which we see daily taken from the streets; but the truth is, the foundations of our pavements are actually carted away as a nuisance.

So much for the causes which will preclude the idea of durable pavements being formed, so long as the circumstances under which they are constructed remain unchanged. Let us, therefore, turn to the chief objects of attention in making a pavement, and the best means of securing its permanent good condition. These are,

1. Uniformity of surface.
2. Durability of materials.
3. The relative and absolute size of the stones.
4. The form or slope of the road.

In the first place it is evident, from what I have said above, that no permanent uniformity can be expected in thoroughfares for heavy carriages where the paving-stones are laid upon earth reducible to a semiliquid mass by every shower of rain, and where large and small stones are indiscriminately used together. I should therefore recommend, that a substratum be formed of more unyielding materials, upon which the paving-stones may be laid. For this purpose I propose flint, limestone, granite, or any other hard stone, broken into pieces about an inch or an inch and a half square, and laid to the thickness of from nine to twelve inches, according as the nature and quantity of traffic expected on the intended road may determine.

I should also recommend, that previous to laying on this substratum of broken stones, the earth, by ramming or otherwise, be rendered as uniformly hard and compact as possible, and its surface brought exactly to the shape intended to be given to the road when completed. Having done this and laid on the broken stones, whose surface must also be made smooth and even, I would cover the whole with a layer of fine gravel or coarse sand, which would facilitate the proper bedding of the paving-stones, and would also tend materially to fix, and to render the broken stones less liable to be moved by any pressure from above.

Secondly, The durability of the pavement, as far as it is affected by actual wear, will depend entirely upon the hardness of the stones employed. Granite and whinstone are almost universally used in London, and both wear well, but the whinstone is the more durable.

Thirdly, When a pavement is to be laid upon a yielding material, it is of great consequence that the stones be as nearly as possible of one size in the same neighbourhood, and that there be no sudden transition from large to small, or the contrary. When a difference of size exists among the stones, the small should be picked out and laid together, separate from the large. Between parts of the street laid with the largest stones, and others laid with the smallest, there ought to be several courses gradually diminishing in size. This would prevent any abrupt junction between the large and the small.

On paving over a bed of broken stones, such attention to equality of size would certainly be of less consequence; yet, as no artificial substratum will be perfectly unyielding, and as uniformity of structure will most effectually contribute to permanent uniformity of surface, I should insist upon its never being lost sight of.

The absolute dimensions of the stones for paving may be determined by considering whether they are to be laid upon a very yielding material, such as earth, or upon one

more firm, such as broken stones. Let us consider the stone in its three dimensions, its breadth, its length, and its depth; by breadth, being understood its dimension parallel with the line of the street, and by length, its dimension across the street; the depth requires no explanation. The breadth of the stone is in all cases to be determined and regulated, first, by what is necessary to a secure footing for horses; and secondly, by the due size of the base. To comply with the first of these conditions, we may assume seven inches as the greatest breadth which may prudently be given, even when the stones are laid upon earth. If upon a firm substratum, such as I have proposed, however, I believe about five inches will be found to give the best footing, and also to oppose less resistance, and occasion less jolting to carriage-wheels, than the broader ones.

If the length of a stone exceed its depth it lies insecurely, being liable to be depressed, first at one extremity, and then at the other. By this the neighbouring stones are loosened, the earth below is churned into a pulp and forced upwards, the stone sinks itself, and destroys the even surface of the pavement.

Although it be scarcely possible to prevent entirely the *depression* of the stones, change of position in any other direction ought not to happen; to whatever extent a stone is driven down, or upon whatever point pressed, it ought to remain parallel with its first position. To effect this, the *depth* of the stone ought to be its greatest dimension; it then not only receives greater lateral support from the stones around it, but, presenting more numerous points of contact, opposes more effectually a direct depressing force, as the neighbouring stones are then made to bear a part in the resistance.

Assuming a general relation between one dimension of the paving-stone and another, I apprehend that if the breadth be taken as 1, the length may be $1\frac{1}{2}$, and the depth from 2 to $2\frac{1}{2}$, according to the wear it may be exposed to.

The absolute size will then be five inches broad, seven and a half or eight inches long, and from ten to thirteen inches deep.

Fourthly, The ease of draught only considered, it is demonstrable, that a perfect plane is the best shape for every road. But as the water must be got rid of, it has been found expedient, particularly in plains and on levels generally, to incline the roads to one side, or to round and elevate them in the middle. This practice has been carried much too far; a very slight inclination suffices to drain off water; and, although a great reformation has of late been effected on our turnpike roads, the extravagantly high rounded pavement still remains a dangerous evil in many of our streets. Some, I know, conceive that the arched form gives greater durability; the pavement, in their opinion, possessing the properties of an arch, each stone deriving support from its neighbours. That this, however, is mere assumption, is shown by the pavements so formed not proving more durable than those which have been laid nearly flat. The rude shape of the stones employed for paving is of itself argument unanswerable against the utility, as it is against the possibility of making a proper arch of the pavement. But even admitting the arch form to answer in some measure the end proposed, it would afford no compensation for the accidents it occasions to horses and passengers, and ought therefore to be entirely abolished.

The advantages which would result from the method of paving upon a substratum of broken stone, are,

1. Greater durability to the surface of the pavement.
2. Greater security both to passengers and horses.
3. Greater ease of draught to horses, and great diminution of jolting to persons riding in carriages.
4. Carriages would not be so speedily shaken to pieces on an even as on a rough pavement.
5. The streets would be almost entirely freed from the noisome mud with which they are regularly covered at present after every shower of rain.

Bryan Donkin.

Design for a Bridge of one Arch, of 600 feet span, in cast-iron, proposed to be erected across the river Thames, near the Tower. By Mr. John Seaward, *Engineer, Poplar.*

Communicated by the Author.

WITH A PLATE.

The accompanying sketch of a bridge of one arch, in cast-iron, of the unusual span of 600 feet, was designed to be erected across the river Thames, just below the Tower Wharf, where a road already exists in a line nearly with the Minories; on the Southwark side of the river, it being proposed to form a new road in as direct a line as possible to the Bricklayers' Arms, in the Kent Road.

The project of building a bridge of one arch across the Thames, high enough for ships to pass under, is nothing new. A plan of a similar kind was proposed many years ago, by Mr. Telford, for the rebuilding of London Bridge. The present plan, however, is supposed to possess some novel features which I apprehend are not undeserving the notice of the scientific and practical bridge builder.

The arch, which will give a clear water way of 600 feet, will spring about 10 feet above high-water mark, and at the crown will be 80 feet above high water, which it is presumed will be sufficient to admit the small vessels under, which usually go above the Tower, without striking their topmast. The curve of the arch is not intended to be any portion of a circle, but is proposed to be a flat segment of an ellipse. My reason for adopting the latter instead of the former curve, is an opinion that flat segments of circles have *a very bad effect* when employed for the arches of a bridge. I shall not dwell upon this point now, but beg to refer the reader to a small work which I have lately published, on the Rebuilding of London Bridge, wherein this subject is particularly adverted to.

The next important feature in the proposed bridge is, that although the arch will be entirely composed of iron,

it will be so constructed, that when painted it will have all the appearance of regular masonry, and will thus harmonize with the stone-work of the abutments. To accomplish this, the whole of the ribs and spandrels are proposed to be covered with plates of iron, with projecting mouldings and cornices, and joints struck to imitate stone voussoirs and regular masonry.

Each rib it is proposed shall be formed of 31 separate pieces, as shown at G, fig. 3, which is the section of a half arch. The pieces are to be formed as shown at E, fig. 5, and will weigh about 14 tons each: then to be connected together by tie-beams, and further secured by a double series of crosses, extending over the whole of the arch, both on the upper and lower side, as shown in the plan of the half arch, fig. 3. The road to be formed on cast-iron plates, in the usual way.

Few persons, who have paid any attention to the construction of bridges, but must have observed what a great impediment is caused to the navigation of the river by the centring required for large arches. In the present case, however, this serious evil will be entirely obviated, for it is proposed to erect the whole of the arch without any centring whatever, by which the river will be freed from all obstacle. To accomplish this desirable object, it is intended to carry up the abutments of masonry to the required height, upon which are to be constructed towers, as B, fig. 3, 40 feet high, of timber framing, sufficiently strong. To the top of these towers wrought-iron rods, A, will be attached, to support the different pieces of the ribs, G, as they are put together, commencing at both the abutments at the same time, and proceeding simultaneously towards the centre of the arch, which being completed, the rods and towers can be removed, and the remainder of the work proceeded with. C, C, are back stays of strong wrought iron, to support the towers: D is the coffer dam, employed in getting in the foundation of the abutments.

In the construction of iron arches, a very heavy expense

is incurred in the necessary chipping and filing all the joinings and connexions of the cast-iron. The whole of this tedious operation will be dispensed with in the proposed work. It is intended to put all the castings together in the state they come from the foundery. All the joinings are then to be carefully loomed round, and the interstices filled solid by melted cast-iron, poured into the joints; a portable cupola or furnace is to be constructed on the arch for this purpose. As all the joints will be made of a dove-tail shape, with sufficient space for the melted cast-iron to flow round, the whole arch will thus be united in the firmest manner, and may almost be considered one entire piece of casting, from one abutment to the other.

The quantity of cast-iron required for the whole of the arch, is estimated at 6500 tons. To this must be added the weight of the road materials, and all adventitious loading, which may be taken at 3500 tons more, making altogether about 10,000 tons. The horizontal thrust upon each abutment, caused by this immense load, will be about 10,500 tons, which is nearly three times the horizontal thrust of the centre arch of the Southwark Bridge. To resist this immense lateral thrust, it is proposed to construct the abutments of great size and solidity; and in which I propose to adopt a novel plan for connecting together the different courses of masonry, the particulars of which will be found detailed in the work above alluded to.

As the elevation of the roadway over the bridge will be very great, the approaches will be formed by inclined planes, supported on arches, the inclination being no where more than about one in thirty.

It should here be observed, that a short time ago it was proposed to erect, on the same scite, a bridge on the suspension principle. Whether this plan is abandoned or not I am unable to say; but I confess my preference is decidedly for a bridge of cast-iron, similar to the one here proposed. That suspension bridges are in their way very admirable structures, is unquestionable; and in unfre-

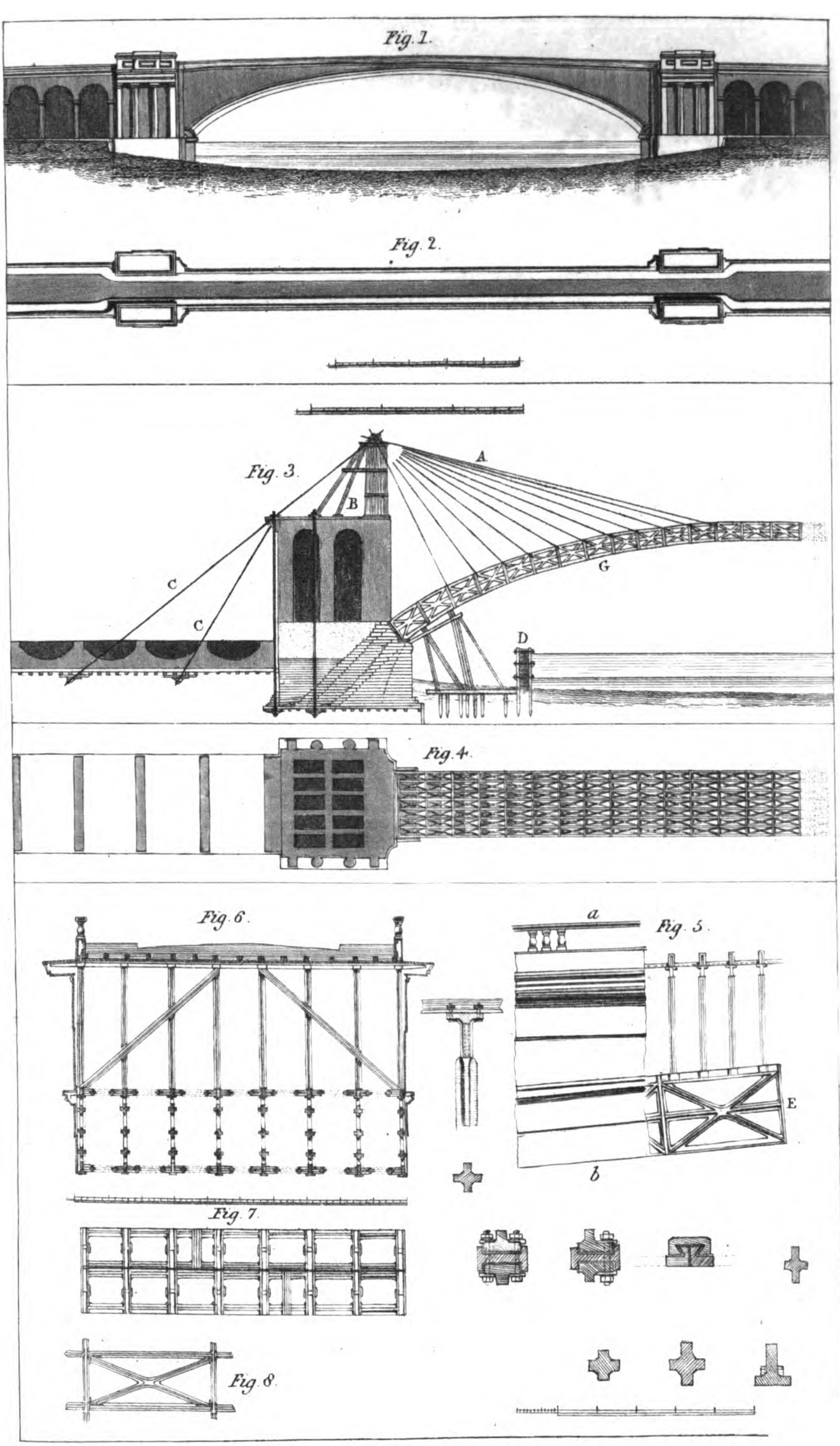


Fig. 1.
Fig. 2.
Fig. 3.
A
B
C
C
D
G
Fig. 4.
Fig. 6.
a
Fig. 5.
E
b
Fig. 7.
Fig. 8.

quented parts of the country, where a cheap substitute for a bridge is required, they may be judiciously introduced; but for a great and crowded metropolis, they do not appear to be quite so eligible. The importance of the first city of these realms requires the public structures to be more substantial and durable.

The bridge now proposed, it is presumed, would have a very ornamental effect. Nothing appears so well calculated to adorn the port of London, or produce an imposing effect to persons sailing up to the metropolis. Of its utility there can be little question, when we observe the very crowded state of London Bridge. There are evidently some other channels of communications wanted between the Eastern and South parts of the metropolis, none of which appear to me to possess higher claims to patronage than the proposed bridge.

REFERENCE TO THE PLATE (XI.)

Fig. 1. An elevation. Fig. 2. A plan. Fig. 3. Section of half arch and abutments. Fig. 4. Plan of half arch, &c. Fig. 5. Part of spandrel. Fig. 6. Section across *a* to *b*. Fig. 7. Tie-beam. Fig. 8. Crosses.

On the Causes of the Hardening of Lime of various kinds.

By M. Hassenfratz.

The different species of lime are in two opposite situations—when they are exposed to air, and when immerged and exposed to the action of water. We will first examine the cause of lime hardening in air, and afterwards that of its becoming hard in water.

If we attentively examine, 1st, what are the results and the progress of the action of air on slacked lime; 2dly, how the banks of limestone have been formed, which owe their production to water, we shall be convinced that the first effect, which immediately takes place on the lime, is

to reproduce carbonate of lime, and that by the facility with which lime attracts from the air, and seizes on carbonic acid. After having observed what takes place in this circumstance, we will examine how the layers of calcareous stones are formed in the water.

All the kinds of lime which we have slacked, and which have been afterwards exposed to the air, contained carbonic acid, which they attracted from the atmosphere; but its quantitv in them was very various. Three causes contributed to determine it,—1st, the state of the air which may contain it in larger or smaller proportions; 2dly, the form and the size of the pieces, the heaps of the slacked lime, and their situation relative to the air; 3dly, the nature of the lime and its degree of purity.

1st, We may conceive that lime slacked in water, that is to say, hydrate of lime plunged into an atmosphere, ought to absorb it more easily as its proportion is larger. Atmospheric air contains commonly but some hundredth parts of carbonic acid; lime saturated with it holds 0·45 of its weight. These two substances, air and lime, have an affinity for the acid; they seize on, and mutually take it from each other, until their affinities are in equilibrium. That which has the greatest affinity for it takes it from the other; but in proportion as that of the two substances which has most affinity for it takes it from the other, its affinity for it diminishes, and that of the other increases. If that of the first is not renewed, it arrives soon at a point where the two affinities are in equilibrium, and there remains no more carbonic acid to be taken up by either. If the substance which has less affinity for it be continually renewed, as takes place with atmospheric air, the equilibrium of affinity takes place, but not speedily; in fine, a time comes when the lime can take up no more. To arrive at this equilibrium, must the quantity of carbonic acid be that which is found in pure carbonates of lime? This is very probable, but there is nothing to prove it. Nevertheless, in very ancient mortars, which have been analysed,

there is often found the same proportion of carbonic acid which exists in carbonates of lime. M. Darcet, for example, has analyzed a Roman cement (Annales de Chimie, vol. LXXIV. p. 315), which produced 0·41 of carbonic acid to 0·563 of lime, which is very near the quantity proper for its saturation, which is 0·45 to 0·55 of lime.

As the carbonic acid combines immediately with the exterior surface of the pieces of hydrate of lime, the air ought to yield much acid to the external layer of the lime before this acid could arrive at the second layer, and it could not reach the third layer but in proportion as this drew off the carbonic acid from the second, which in its turn extracted it from the first. It is only by the difference of the affinity of each layer for carbonic acid that they reciprocally take this substance from each other; and as the layer which has less of this acid ought to have a greater affinity for it than that which has more, it may be conceived how this filtration of the acid takes place, and likewise how much time it would require to penetrate a layer of a small thickness. M. Vicat having in this manner exposed quadrangular prisms of lime to the action of the air, has observed that after 18 or 20 months of exposure, the regenerated layer was only some millimetres in thickness. Wherefore, as a mass of lime of but a few thousandth parts of a metre in thickness, which is that of the layer which had been saturated, could be regenerated in that time, it is only necessary in order to completely reproduce carbonate of lime, to reduce pure quick lime into very small plates, of only a few millimetres in thickness; but as the prisms on which M. Vicat made his experiments were exposed to dry air, it might happen, if they had been exposed to moist air, this moisture would have favoured the penetration of the carbonic acid, and that a greater thickness would have been regenerated.

With regard to the nature of lime, and to its degree of purity, experiments have been made by Smithson Tenant, on the proportion of carbonic acid absorbed in the same

time, and under the same circumstances, by lime produced from pure carbonate of lime, and from the carbonate of magnesian lime. He has observed that pure lime, exposed on the earth to the action of the air, and to all the vicissitudes of the atmosphere, had regained, at the end of three months, 0·8 of carbonic acid, while magnesian lime, composed of three parts lime and two of magnesia, had only regained 0·42. Mortar made with pure lime had absorbed, at the end of 23 months, 0·63 of the carbonic acid, which its carbonate contained; and mortar, made with magnesian lime, had only absorbed of it, at the end of three years, but 0·45, and at the expiration of eight years, 0·47. These results lead to the belief, that pure lime absorbs carbonic acid with more facility, and in greater quantity, than when it is mixed with other substances. As to the rest, the few experiments made hitherto on the proportions of carbonic acid absorbed by pure lime and by poor limes, prevent any satisfactory conclusions from being made, and we must wait until new experiments add new facts to the small number which have been as yet collected.

From observations and experiments made to the present period, on the absorption of carbonic acid by limes and mortars employed in buildings, it would be difficult to conclude that their hardening proceeded only from the carbonic acid, combined with the lime. Besides, the analysis made by M. Darcet, of a very ancient mortar of Sarrebourg, which only gave 0·294 of carbonic acid, with 0·426 of lime, while there ought to have been 0·33 for its saturation; and the analysis of the mortar of magnesian lime, made by Smithson Tenant, which in eight years had only taken up 0·47 of the carbonic acid necessary for the reproduction of the carbonate, although this mortar was taken from the outside, seem to prove that it is only with great difficulty, and after a very long period, that lime in buildings can become combined with the carbonic acid necessary to regenerate the carbonate of lime; thus, every thing leads to the belief that another cause acts powerfully

on the prompt hardening of limes and of mortars exposed to the air. Moreover, as the carbonic acid combines with the surface, this surface becomes hard, and keeps the mass of lime of the same dimensions which it had at the moment of the combination; and as the lime in hardening diminishes in bulk, it follows that it ought to form, at the time of the internal hardening, cracks and clefts, like clay dried quickly in the air, which cracks render the lime brittle, of little tenacity, and even friable.

We are still ignorant in what manner *oxigen* acts on lime; but every thing leads us to believe that some action takes place, since, according to the experiments of M. Treusart, colonel of engineers, various species of lime, both fresh from the kiln and slacked, being exposed beneath glass jars to the action of atmospheric air, that which was dry, and not slacked, absorbed but a very small portion of the oxigen of the air, while the lime which was slacked and moist absorbed a large quantity.

Let us now examine the manner in which the beds of carbonate of lime, which are formed in water, have been able to acquire the degree of hardness which they possess.

As there are different theories on the formation of the beds of carbonate of lime, some attributing them to fire, and others to water, we will only at present consider the beds of calcareous stone, which bear evident marks of their aquatic formation; that is to say, which contain either marine or river shells. These stones very generally lie in horizontal beds, which are separated from each other by clay, or various other substances in a soft and unsolid state.

We may divide these sorts of calcareous stones into two species, the chalks and the coarse limestones; that is to say, having grains more or less coarse. Some, however, as the stone of Chateau Landon, lias stone, &c. have smooth fracture and a fine composition. Their hardness is also extremely variable, from chalk and the tender stones, which may be broken by the hand, to those which

are very hard, very firm, and which are only broken by a considerable blow. This hard variety, according to the experiments of Rondelet, bears between 9616 pounds (as the *Cliquart* of Vaugirard), and 595 (as the *lambourde* of Montesson); which weights were used in crushing a rectangular prism of two inches every way.

What may appear extraordinary to those who have not observed the order of the superposition of these sorts of stones is, that chalk, the most tender stone, is the most ancient; it is placed in every soil below the coarse lime-stones and building stone; a bed of clay, in many places extremely thick, separates it from the harder and less brittle stones, which proves that it has been deposited many ages before the other sorts. To which we will add that, as all these stones contain marine shells, it is evident that they were formed beneath the sea.

Among the means which nature has employed to produce these calcareous stones, we may distinguish three. 1st, Carbonate of lime, which has been held in solution in the water, and which has been precipitated from it gradually. 2d, Calcareous earth, which has been carried off and held in suspension in the water, and has been afterwards deposited. 3d, The waters have held calcareous stone both in solution and in suspension, and have deposited both, either at the same time or successively.

1st, We know that water acidulated with carbonic acid dissolves carbonate of lime, and that it abandons it in proportion as the superabundant carbonic acid evaporates. The stalactites and the stalagmites, which are formed in grottoes, are only produced by acidulated waters holding carbonate of lime in solution. These waters are filtered through the materials of the vaults of these cavities; the acid evaporates, the carbonate of lime, abandoned, adheres to the surface which the water has moistened, and thus forms by accumulation those beautiful columns of stalactites and stalagmites. When these waters, acidulated and saturated with lime, pass out through apertures, and run

off exposed to the action of the air, the ground beneath becomes covered with solid layers of carbonate of lime, more or less thick. Finally, if these aerated waters, saturated with carbonate of lime, collected in large quantities, form basins, or run off in the form of rivulets, they deposit solid carbonate of lime on their bottoms, and on the solid substances plunged into them; they thus produce incrustations more or less beautiful.

It is possible that chalk owes its formation to a similar cause; the fineness and the whiteness of its consistence give reason for this supposition. The solutions of carbonate of lime might be brought down by the rivers into the sea, where, mixed with those of this vast basin, for a certain distance from the coast, the carbonate of lime would be deposited in the whole extent in a very fine powder, in proportion as the dissolving acid was evaporated: and other solvents might have produced a similar effect.

But this cause of the precipitation, and of the deposition of carbonate of lime, could only endure for a certain space of time, after which it would cease, either from the dissolving aerial waters becoming exhausted, or from the masses of carbonate of lime being worn away; then the waters being only loaded with clay which they held in suspension, would become equally extended and mixed with the water of the sea, where they would slowly deposit this earth; and the clay thus deposited has produced the considerable beds of plastic clay which cover the masses of chalk.

As these chalks are not always very pure, and some of them, as those of Meudon, contain magnesia, and as others of them contain clay, and others of them, finally, silex, it is possible that those other earths might have been held in solution or in suspension in those same waters, and that they might be precipitated at the same time with the carbonate of lime. The waters of the sea contain at the present time, in solution, the muriates and sulphates of lime and of magnesia, and of other bases.

As to the calcareous stones and the building stones, which are placed above the masses of plastic clay, every thing leads to the belief that they have another origin; the coarseness of the grain of the composition of most of them gives reason to suppose that these substances have been carried down by the waters, and precipitated by the repose of the mass.

2dly, At distances more or less great from the coasts, the waters of the sea might wash away and carry off, in their movements, fragments, and calcareous sands. The waters of the rivers, in throwing themselves into the sea, might also carry with them calcareous sands. These waters, mixed with those of the sea, have been transported along with them in the movements and currents to which they are subject. The above materials might be deposited, as those of the rivers, in some places in large grains, in others in fine grains, and in others in mixed grains. It is thus that sands, more or less coarse, or more or less fine, are still deposited at the bottom of the sea; but this does not, however, explain their consolidation, or the hardness which the stones have acquired.

We may moreover conceive, that the hardening of the grains of calcareous sands, thus deposited, is occasioned by the affinity of the water for the fragments of the calcareous stones, which it moistens, and to which it adheres with great force; and that a species of paste, or of mud, formed by the finest dust, shall have filled the intervals which the grains, more or less coarse, have left between them, and shall have formed a species of cement or earthy mortar. If afterwards we suppose that, by the compression of the water and of the other masses of stone, deposited one above another, the layer of water placed between the particles, whether of the grains, or of the mud, has been successively diminished, we may conceive it reduced to a thickness so very small, that the film of water interposed, which we may consider as the water of cohesion, and assimilate with the water of crystallization,

shall exercise its action on the two surfaces of stones brought close together, and effect, in this manner, a cohesion more or less strong. It is thus that we make to adhere to each other two plates of glass well polished, in moistening them slightly, and compressing them strongly against each other. It is also by a similar mechanism that clay, beaten together or kneaded, acquires hardness in drying; that it diminishes in bulk by the approachment of its particles, and diminishes the thickness of the film of water which adheres to each of them. If, after drying them slowly, we expose the masses of clay to the fire, and evaporate a part of the water which they contain, the masses of clay diminish in bulk, and the particles adhere, in proportion as the film of water decreases in thickness. The diminution of the thickness, and of the force of cohesion of the particles, increase until all the water is evaporated. In this circumstance the particles being brought sufficiently close together for the exercise of their mutual affinity, the force of cohesion may be thus reduced to the simple action of the molicules, and arrive in this manner at its greatest strength.

Probably a similar effect takes place in these sorts of stones in taking them from the quarry; the force of adhesion of the particles may be attributed in part to the water of cohesion, that is to say, to the thickness of the film of water which separates them, and to the action of the molicules on each other. In moistening the stones, we increase this thickness of the films of water, and we diminish the force of cohesion; in heating them without disengaging the carbonic acid, that is to say, in drying the stone, we diminish the thickness of the films of water, and increase the force of cohesion and the hardness. But if we raise the temperature sufficiently to evaporate the carbonic acid with the water, considerable cavities must be formed, since the substance loses 0·45 of its weight. If its volume were diminished in the same proportion, that is to say, if it were only 0·55 of its former bulk, the par-

ticles would be brought still closer together, and, by this approachment, the force of cohesion of the particles would be considerably increased: but the bulk being commonly diminished only a tenth, the particles ought then to be still at a great distance, and leave considerable interstices in the mass. However, even at this distance, the solidity of the lime is very great, and sometimes even greater than that of the stone that produced it. If the lime had retained the bulk of the stone, and the mass had still remained solid, we might attribute the first solidity solely to the cohesion of the particles; but as it has been diminished in bulk in the calcination, and as the particles are brought closer together, we may attribute in part the hardness of the stone to the action which the water exercises on its particles; for the water formed only a small part of the substance disengaged. Every thing then leads us to believe, that it is to the evaporation of the water which separates the particles that the small diminution of the bulk is due, and that the disengagement of the carbonic acid has principally contributed to render the density less great.

We may equally attribute the formation of chalk to carbonate of lime extremely divided, suspended in the water, and precipitated by the repose of the masses, and then compressed by the mass of water lying above it, which pressure would cause the water to pass out that was more than was necessary to effect the cohesion of the particles. We may every day observe a similar result to occur in the fabrication of whiting, or Spanish white. The chalk, divided, washed, and suspended in the water, becomes precipitated, and is united at the bottom of the reservoirs of water, and there forms a mass, the particles of which have a sort of cohesion. This precipitate is not left a sufficiently long time to cause it to contract a solidity as great as that of chalk, and, besides, the pressure of the column of water over it is not so considerable. This paste is taken out of the reservoirs, where it has been precipitated, still soft; rolls are formed of it, which are exposed

to the action of the air; it becomes dry in consequence, and the whiting, by the evaporation of the water, acquires some little solidity, hardness, and resistance. If, during the drying, this paste of chalk had experienced a continual pressure, which would have obliged its particles to have approached each other with more force, then the chalk would have acquired a much greater hardness, of which we have satisfied ourselves, by drying pastes of chalk and of calcareous stones, which we have pulverized and reduced to the state of mud. Putting this mud into vessels, and covering them with a weight sufficiently heavy to compress the mass constantly during the drying of the coarse calcareous stone which we had pulverized and washed, the troubled water being decanted, gave us, on the repose of the masses, a very fine paste; which paste, dried by itself, and exposed to a constant pressure, gave us a stone pretty hard, analogous to the tender calcareous stones, of a very fine grain, or very fine composition. This paste, mixed with the powder of the same stone, in grains more or less coarse, and submitted likewise to a constant pressure while being dried, produced also, after six months' drying, a stone tolerably firm and hard, but, however, a good deal less hard than the stone which had been powdered. But in this case we had not the benefit of the pressure, continued for ages, which have passed away, since the precipitation and the deposition of the sands, and of the calcareous powders.

3dly, It might be possible, and even probable, that carbonate of lime in solution should be precipitated at the same time with carbonate of lime in suspension, and that this first carbonate of lime had served as a cement, and had contributed to reunite the suspended particles; but on the other side we have no reason either to admit or reject this mode of formation of solid mortars, if it be not the difficulty of conceiving that this carbonate held in solution, in abandoning the powder of the carbonate of

lime, carried away equally by the water, could be sufficient to produce such an effect.

Belidor speaks of an analogous formation, in vol. IV. p. 173, of his Hydraulic Architecture. "In proportion as the beds of stone have been formed," says this excellent engineer, "the sea covers them with its mud, and with an immense number of small shells, which become attached to them, without speaking of the sand which is deposited in their interstices. All these things together cause a concretion, which at the end of some time occasions the stones to unite to one another so as to form only one single body, like that of masonry, of which we have many examples. And lately, at the bar of Bayonne, vast labour was necessary to destroy some ends of dikes, which were made anciently with pieces of waste stones; they were found as indestructible as if they had been united by the best cement."

We may see from this passage that the shells, which are found abundantly in some calcareous stones, might have contributed to their hardness by the addition of a gluten, similar to that which produces the hardness and solidity of corals; but as we do not find small shells so abundantly in all the calcareous banks, we are obliged to attribute the formation of those which do not contain them to another cause.

From all this it results, that it is not probable that we owe to the action of the carbonic acid on lime the formation of the banks of chalk, and of calcareous stones, the masses of which have evidently been accumulated and solidified in the water, but much rather to the action of the adhesion, combined, of the water on the particles of carbonate of lime, and of the particles of carbonate of lime on each other.

(*To be continued.*)

Report of the Select Committee of the House of Commons, appointed to inquire into the state of the law and its consequences respecting the Exportation of Tools and Machinery. (Continued from p. 269.)

With respect to the second objection, the apprehension of being undersold in the foreign market, the evidence of those witnesses in whom this apprehension is most prevalent, contains much which seems to incline in a contrary direction to the inferences drawn by them. It is admitted by them that we possess many facilities which foreigners do not, and may not for ages possess. Our minerals are generally in immediate neighbourhood, whence, from the proximity of rail-roads, canals and rivers, they may be conveyed with great facility to all parts of the kingdom, either for home manufacture or exportation. Almost all our great manufacturing towns, and establishments for the construction of machines, enjoy similar facilities; and thus, with the continual improvement of machinery, enable us to keep down the cost of production.

Upon this subject your Committee beg to refer to the following extracts from the evidence of Mr. M'Culloch, which, in their opinion, deserves the most serious consideration.

" Do you conceive that the laws rather assist the French " than otherwise, in being able to establish manufactories " of machinery of their own?—I should think our pre- " venting the exportation of machinery to France has a " tendency to force the French to become machine-makers " themselves, and to rival us in a branch of industry, into " which, if they could get machines from England, they " would have no motive to come into competition.

" Those laws make it more a matter of necessity on the " part of the French to induce our machine-makers to go " to France, to instruct them in the art of making ma- " chines?—Unquestionably.

" Do you conceive that if the French were to acquire " equally good machinery with ourselves, that it would be

"injurious to our manufactures?—No, I do not think it "would.

"By their obtaining our machinery, so as to be able to "meet us in the market for cotton and other goods, will "not that be injurious to us?—I do not think the circum- "stance of getting our machinery would enable them to "meet us in the market with cottons, or any other goods, "with advantage.

"Will you state what it is that would give England the "advantage in that case over the foreign manufacturers? "In the first place, the French manufacturer would not "have the same degree of security that the English ma- "nufacturer has; in the next place, you have the advan- "tage of better communications throughout the country, "the advantage of trained workmen, habituated to all "industrious employments, and of a better division of "labour; so that, though the French imported from us "as good machinery as we have, you would still have "many incommunicable advantages which they could not "have, and you would always have cheaper machinery in "proportion to the cost of the transfer of the machines "into France.

"Will you have the goodness to state to the Committee "the advantages that would accrue to England from the "exportation of its machinery?—The advantages would "be, that in addition to all our present manufactures we "should have an additional branch of manufacture, cor- "responding in extent to the extent that the foreigner "took machines from us. You would thus have a new "field created for the profitable employ of capital and "industry, which you have not now."

Your Committee think proper to notice, as a third objection entertained by many of the witnesses, viz. that, in consequence of the low rate of wages paid on the continent of Europe, manufacturers in foreign countries would be enabled to sell their goods cheaper than we could sell ours.

Your Committee are sensible of the propriety of paying

due attention to this objection; as not only many of the witnesses whom they have examined form their opinion of the impolicy of allowing machinery to be exported, on the grounds that the low wages of France and other nations secure to those countries advantages over England; but almost all persons of all descriptions consider this doctrine of the advantage of low wages as forming a settled axiom in political economy, and therefore as one which admits of no question whatsoever; but so far from this being a doctrine that ought to be universally received as sound and settled, your Committee are of opinion that many facts exist to show that doubts may be justly entertained respecting its validity. Experience proves, that in those countries where wages are low the workmen are often indolent, and so unskilful as to be incapable of producing any commodities but such as are of the rudest and coarsest kind; one workman is employed in two or more different operations in the same fabric, and little or no assistance is given to manual labour by inventions to abridge and economize it; whereas in those countries where wages are high the workmen are generally active, spirited, persevering, and exceedingly skilful; no article is too delicate or difficult for them to make; the principle of division of labour is in full operation, and every description of machinery is made to contribute extensively to the diminution of manual labour.

It is well known to those who have attended to what has taken place in respect to the cotton manufacture in Ireland, (and it has been alluded to in the evidence,) that when Mr. Pitt in 1788, and at the Union, proposed to lower the duties on cotton goods imported from Ireland into England, the witnesses who were then examined before Committees of this House, resisted his plans on the same grounds that the witnesses whom your Committee have examined object to the exportation of machinery, namely, the advantages which a country with low wages has over a country in which wages are high. But although

Mr. Pitt, at the Union, lowered the duties on cotton goods imported from Ireland into England to ten per cent.; and that cotton goods could be sent from Ireland to foreign countries to be sold there in free competition with English cotton goods; and although Ireland has imported from time to time the best English machinery, and employed the best English workmen to instruct the Irish workmen, yet Ireland, under all these circumstances, (with an average rate of wages of 3*d*. or 4*d*. a day, as proved in evidence before the Committee on the state of Ireland,) was not able to do any thing worthy of notice in the cotton manufacture till the repeal of the duty of ten per cent. in 1823 led to the sending of English yarn into Ireland to be wove there, and returned to England, and till English capital was employed in Ireland to promote the industry of her people, by giving orders for goods to be sent to England to enable the English manufacturers to make good those orders which they could not execute in England.

The case of England herself is also in point, to show that low wages may be counterbalanced by other circumstances; for though wages in England are much higher than wages in other countries in Europe, yet almost every kind of manufactured goods that are required in great quantities can be made so much cheaper and better in England as to find a market in almost every foreign country.

But besides these facts, tending to disprove the doctrine that low wages always give to a country advantages in carrying on manufactures, there exist the reasonings and conclusions of those learned and observing persons (who during the last fifty years have reduced the rules that govern the operations of industry and trade to a science), to explain in what way they consider this doctrine to be wholly untenable. These eminent persons undertake to show, by arguments and facts, that the effect of low wages is not a low price of the commodity to which they are applied, but the raising of the average rate of profits in the country in which they exist. The explanation of this

proposition occupies a large portion of the justly-celebrated work of the late Mr. Ricardo, on the Principles of Political Economy; and is also ably set forth in the following evidence of Mr. M'Culloch, to which your Committee particularly desire to draw the attention of the House:

"Have you turned your attention to the effect of fluctuations in the rate of wages on the price of commodities? "I have.

"Do you consider that when wages rise the price of "commodities will proportionally increase?—I do not "think that a real rise of wages has any effect whatever, "or but a very imperceptible one, on the price of commodities.

"Then supposing wages to be really lower in France "than in this country, do you think that that circumstance "would give the French any advantage over us in the "foreign market?—No, I do not; I do not think it would "give them any advantage whatever. I think it would "occasion a different distribution of the produce of industry in France from what would obtain in England, "but that would be all. In France, the labourers would "get a less proportion of the produce of industry, and the "capitalists a larger proportion.

"Could not the French manufacturer, if he gets his "labour for less than the English manufacturer, afford to "sell his goods for less?—As the value of goods is made "up wholly of labour and profit, the whole and only effect "of a French manufacturer getting his labour for less than "an English manufacturer is to enable him to make more "profit than the English manufacturer can make, but not "to lower the price of his goods. The low rate of wages "in France goes to establish a high rate of profits in all "branches of industry in France.

"What conclusion do you come to in making a comparison between wages in England and wages in France? "I come to this conclusion, that if it be true that wages "are really higher in England than in France, the only

"effect of that would be to lower the profits of capital in "England below their level in France, but that will have "no effect whatever on the price of the commodities pro-"duced in either country.

"When you say that wages do not affect prices, what 'is it that does affect prices?—An increase or diminution "of the quantity of labour necessary to the production of "the commodity.

"Supposing that there was a free export of machinery, "so that France could get that machinery, do you think "that under those circumstances we should retain those "advantages which we possess at the present moment?—"Yes, we should; for the export of the machinery would "not lower our wages, or increase the wages in France, "so that we should preserve that advantage to the full "extent that we have it at this moment.

"Will you explain to the Committee why you are of "opinion that the French manufacturer would not under-"sell the English, seeing that his profits are larger than "the English manufacturer?—Because if he were to offer "to undersell the English he can only do it by consenting "to accept a less rate of profit on his capital than the "other French capitalists are making on theirs, and I "cannot suppose a man of common sense would act upon "such a principle.

"Are the Committee to understand, that although a "French manufacturer pays half the wages to his men in "France, which our manufacturers do in England, yet "that his wages being on a par, or a level, in general, "with the other wages in France, will render his profits "on a par with them, and consequently he would not "undersell the English merchant by lowering his profits "below the average rate of profits in France?—Precisely "so. I believe, in point of fact, there is no such dif-"ference; but he could not undersell the English manu-"facturer unless he took lower profits than all other pro-"ducers in France were making. I might illustrate this

"by what takes place every day in England, where you "never find the proprietor of rich land, in order to get rid "of his produce, offering it in Mark-lane at a lower rate "than that which is got by a farmer or proprietor of the "very worst land in the kingdom.

"Would it not produce a larger sale if the French ma-"nufacturer were to sell at a lower price?—Supposing that "to be so, the greater the sale the greater would be the "loss of profit."

It is the opinion of many of those who object to the exportation of machinery, that Great Britain owes her present superiority in manufactures solely to the excellence of her machinery; but the evidence already noticed, as well as that of Mr. Martineau and others, would incline your Committee to believe that many other circumstances had tended to produce that effect, and that if the exportation of machinery was generally permitted, English engineers would supply the greater part of the world, without endangering her present superiority. "My reasons," Mr. Martineau says, "for forming this opinion principally "consist in the natural advantages that England possesses, "from the circumstance of the iron stone and coal being "invariably found in the same spot, and thus affording a "means of manufacturing iron at a cheap rate; the talent "and ingenuity of the workmen; the immense spare capital "we have in this country; the circumstance of our canals "and railroads already established, enabling us to bring "the raw material from the interior of the country at a "very low rate; it would of course take a considerable "time before France, or any other country, could possess "any of those advantages, even those which cannot be "considered as peculiar only to us, such as canals and "railroads."

To be concluded in our next Number.

Process for the Rectification of Alcohol without heat.

From the Annales de Chemie, May 1825. By M. E. Pajot Dechارme.

Hitherto alcohol, or more properly brandy, could not be rectified, or raised from an inferior to a higher degree, and consequently be brought to a superior state of purity and strength, except by distillation, an operation which could only be effected by an alembic and some heat.

The mode of rectification here treated of can be performed in the cold, and consequently without the aid of an alembic or of combustibles. The following in general is the method of proceeding:

On the one part there is poured into a vessel with a flat bottom a given quantity of the alcohol, which is desired to be rectified, whether it be small spirits (*petites eaux*), proof spirits of Holland, or spirits of a higher degree.

On the other part one of the most deliquescent salts is to be dried, either muriate of lime, or muriate of manganese; the first is preferable in point of economy, and the superiority of the second gives it a claim to be chosen; but it is less common, and not so easily obtained.

In another vessel with a large surface, and placed on three or more feet in the vessel which contains the spirits, is to be put the muriate of lime dried and pounded.

This disposition being made, the vessel which holds the alcohol is to be closed up completely, or its edges are to be secured with bands of paper pasted over them, and the whole is to be left in this state for four or five days. After this time the vessel holding the spirits is opened, and that containing the muriate is taken out. This salt is then found to be more or less dissolved, according to the quantity of water which it has attracted. The degree of strength of the spirits is then examined, and it is found to be increased 5, 6, or 8 degrees, according to the fineness of the grain of the dry muriate; it ought not however to be too fine, to prevent its becoming pastey, and to make its surface more extensive; the vessel holding the muriate is then cleaned, a new portion of the dry muriate is spread on it, and it is put back into its place, and then

the vessel containing the spirits is again shut up in the same manner as before the insertion of this second dose of deliquescent salt.

By operating successively in this manner, highly rectified alcohol is obtained, and weak spirits of 10 or 15 degrees (of Baume's areometer) are raised to 40 or 42 degrees.

It may be conceived that this method may be applied to the concentration of various saline fluids, acids, &c. and that by a particular disposition of the factory, basins, &c. it would be easy to establish a rotation (of the processes), which, in a given time, would afford at pleasure daily products of all degrees of concentration.

M. Decharme is at present employed in trying to give to this process, by the aid of mechanism and natural philosophy, all the regularity, precision, and perfection, desirable for a work on a large scale.

Preparation of a colour named Vienna Green. By Dr. Liebig. From the Bulletin de la Société d'Encouragement, Vol. xxii. (1823.)

Dissolve with heat, in a copper boiler, one part of verdigris in a sufficient quantity of pure vinegar, and add an aqueous solution of one part of white arsenic. During the mixture of these liquids, there commonly forms a dirty green precipitate, which it is necessary, for the beauty of the colour, to make disappear. For this purpose, a fresh quantity of vinegar is added, till the precipitate shall be re-dissolved. The mixture is then boiled, and after some time a granulary crystalline precipitate is formed, of a most beautiful green colour, which being separated from the liquid, well washed and dried, is nothing else but the green colour in question.

If the liquor still contains an excess of copper, more arsenic is to be added; and if it contains an excess of arsenic, it is necessary to add more copper, operating in other respects in the same manner. It often happens that the liquor contains an excess of acetic acid; in this case it may be employed anew, for dissolving verdigris.

This colour, thus prepared, has a blueish cast; but in commerce a deeper and yellower shade is required, retaining the same brightness and beauty. To produce this change, it will be sufficient to dissolve a pound of the potash of commerce in a sufficient quantity of water, adding to it ten pounds of the colour obtained by the above process, and heating the whole by a moderate fire. The mass soon deepens in tint, and takes the shade required. If it be boiled too long, the colour will incline to Scheele's green, but will always surpass it in beauty and brilliancy. The alkaline liquor, remaining after this treatment, may still serve for preparing Scheele's green.*

A useful glazing for common earthenware. By M. Roschinski. From the Bulletin de la Société d'Encouragement, Vol. xxii. (1823.)

M. Rochinski, a manufacturer of earthenware at Berlin, has found a varnish or glazing for common pottery, which, after trials made in the presence of the college of medicine, offers no danger in regard to health, and resists the action of the acids. This glazing is composed of five parts of litharge, two parts of well purified clay, and one part of sulphur. These substances are pulverized, and mixed with a sufficient quantity of caustic alkaline lie, (soap-makers' liquor) so as to form a mixture fit to be readily applied on the earthenware, and to cover it equally all over. Carefully baked, these wares offer no trace of lead.

The reader will find a short account of the new kinds of glaze, called *lustre,* made with precipitates of gold and platina, in Dr. Brewster's Encyclopedia, Vol. xvii. p. 137. in the article Pottery; an article much too brief, when we consider the importance of the subject, and the space devoted to matters of less moment: for instance, Pyrotechny occupies no less than 64 pages of the volume referred to, while Pottery occupies but two pages and a half! M.

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* Scheele's green is a combination of deutoxide of arsenic and deutoxide of copper.

NOTICES OF NEW PATENTS.

Patent granted to THOMAS CARTMELL, *of Doncaster, gun-maker, for an improved cock, to be applied to the locks of any gun, pistol, fire-arms, or ordnance, for the purpose of firing the same by percussion, acting either by self-priming or otherwise, and whereby the priming is rendered wholly impervious alike to the rain, wind, or damp.* Dated November 6, 1824.

THREE methods are described by the patentee for effecting the purposes recited in the above title. The first is for the application of single percussion balls, each time that the piece is primed; the other two are for self-priming from small magazines of these balls.

The machinery of the locks is the same as for common percussion locks, the improvements of the patentee being confined to a little apparatus placed on the top of the cock, which, except immediately beneath this part, is not different from a percussion cock of the usual form.

In the first method, a small cavity is made in the front of the cock, sufficient to hold a single percussion ball, which cavity is placed so as to fall upon a point projecting from the lock, called here the "striking peg," through which the touch-hole is drilled into the cavity of the piece; one of the small percussion balls is put into this same cavity, either by hand, or by a charger, each time that priming is required, where, if not prevented, it would be liable to fall out, and to be spoiled by wet; but, to preserve it from these accidents, the patentee has contrived a little cap that shuts over it from above, which is fastened to the hinder part of the cock by a hinge or joint, where a small knob projects from it, against which a thin spring presses that runs up the back of the cock, to which it is fastened at its lower extremity by a screw; the use of which spring is to keep the cap fixed in its place, either when shut down, or when entirely raised. As the front of the cap lies exactly before the percussion ball when shut down, in order to raise it out of the way of

the percussion, when the cock is let go, a sloping "cheek" projects from its inner side, which, in the descent of the cock, strikes against a piece that projects for that purpose from the side of the lock, that by the action of the inclined plane of the cheek produces the desired effect; the cock then passes on, holding the percussion ball entirely uncovered, drives it against the striking peg, and ignites it by the percussion.

The second method, in addition to the cap above described, has a small magazine, like a flat thimble, that fastens on the top of its fore part by a dove-tailed slide, with a hole in its lower part near the front, through which a single percussion ball only can fall at once into a small receptacle prepared for it in front of the cock. To prevent the rest of the balls from falling out when the cap is raised, a thin flat spring, that lies on the top of the cock, passes below the hole through which the balls fall when in that position, and closes it until the cap is put down; which motion removes the hole from over it, and again leaves the passage open. These different relative positions of the spring stopper, and of the front of the cap, are effected by merely having the joint of the cap at the back of the cock placed about half an inch lower down than the fast end of the spring, by which means the cap, in being raised by its sloped cheek, is also pressed back along the front of the spring stopper; and again in being shut down passes forward over it, so that the hole in its front goes entirely beyond it, and leaves the passage for the percussion balls unobstructed.

In the third method there is no moveable cap, but the magazine for the percussion balls is fixed directly on the front of the top of the cock, and close beneath it a small square bolt passes through the head of the cock from the back to the front; near the front of this bolt is a hole, through which the balls pass, one at a time, to a small receptacle beneath in the front of the cock, by which it is conveyed to the "striking peg," as in the other methods, when the cock is let go; at which time the bolt is pressed

back, by a part that projects from the lock for that purpose, so that the solid part of it comes beneath the opening of the magazine, and prevents all communication between it and the receptacle; the bolt is again restored to its first position, when the cock is raised by a spring that lies flat against the back of the cock, whose upper part acts on the bolt, and lower part is fastened to the cock by a screw.

To keep the small percussion ball in the receptacle, another spring is placed at the side of the head of the cock, directly below the bolt, having a triangular head, which closes up the front of the receptacle when the cock is raised; but, as soon as it is let go, the side of the triangular head farthest from the spring comes in contact with the side of the striking peg, which, by the action of the inclined plane, moves it to one side, from before the percussion ball, and leaves the latter exposed to the top of the striking peg, against which it is forced immediately after, and ignites the charge.

These contrivances are all very ingenious; but the first of them, of which the inventor thinks least, seems preferable for its simplicity, and for being least liable to accidents of explosion, to which we think all magazines for percussion powder subject, though we confess that those above described are as little so as any we have seen.

It appears to us also that the magazines have no certainty of delivering the balls as the patentee states; but that on the contrary they would be very apt to obstruct one another in their descent, so as not to be made to come down without taking off the magazine to free them, to which accident they would be peculiarly liable in damp weather, which would more or less affect the chlorite of potash, or other explosive salt in their composition, so as to make them somewhat adhesive at their surfaces; for though the cap defends the percussion balls well against rain, it could not protect them from atmospherical moisture, which must penetrate wherever the air has any access.

Patent granted to Alexander Dallas, *of Holborn, Engineer, for a machine to dress or pick stones of various descriptions, particularly granite stone.* Dated April 27, 1824.

This instrument is the same in principle as some tilting hammers used in forging; and consists of a rafter, or beam, suspended on a pivot between two uprights, which pivot is nearer one end, so as to divide it into a long and a short arm. At the end of the short arm a vertical wheel is placed, from 9 to 15 feet in diameter, in the plane of the rafter, from whose edge three catches project, at equal distances from each other, which, as the wheel is turned round, in succession depress the short arm, and thereby elevate the long arm, to whose extremity a block of wood is fastened that holds the chisel, or other cutting tool, which is to pick or dress the stone which is placed beneath it; and which block falling down as the catch passes from the short arm, by its weight and accelerated velocity strikes the tool against the stone in any place directed by the workman; it being so placed beneath the tool in a truck that stands on a small platform, which turns horizontally on a vertical pivot, that by moving the truck by its handle, he can easily bring it into any position required, and of course cause the tool to strike it wherever he pleases.

The height to which the tool is raised above the stone by this wheel is from one to three feet; and to guide it more exactly in its fall, two other uprights are placed near the end of the short arm, between which it moves up and down. The wheel may be turned by human labour, by horses, wind, water, or steam, as preferred, in any of the usual methods of applying these powers.

The present high price of cut stone, and the great advantage to be derived from a more extensive use of it (particularly in preventing fires, when applied in staircases), renders every contrivance of importance which may tend to reduce its cost, by diminishing the human labour necessary in cutting it to the form required.

The machine above-described might be improved by the addition of a wooden spring above the longer arm, similar to those which are used for tilting hammers; and also by having the catches placed nearer the centre of the wheel, instead of their being on its circumference, by which the wheel would have more power as a fly wheel in regulating the equality of the power and of the blows.

Where a number of holes would be required to be cut in a line, for wedges to split the stone, a set of upright spars, made to move up and down vertically, in a similar manner to the drivers of an oil mill, would make quicker work by cutters fastened to them, than this patent machine; particularly if the cutters were made to move a little round their own centres, so as not to fall precisely in the same spot at each descent.

Patent granted to Mr. Samuel Crosley, *of Cottage-lane, City-road, for certain apparatus for measuring and registering the quantity of liquids passing from one place to another.* Dated 1st Feb. 1825.

The patentee states his object to be, in this apparatus, to produce a method of measuring the quantity of liquor, that passes from one vessel to another placed at a lower elevation, where consequently the liquor will sustain a greater pressure; this apparatus he calls a "liquid-meter," and describes two different forms for its construction, the latter of which is more proper for measuring liquors of a thicker consistence.

The first form of the instrument described resembles the gas-meter, used sometimes for registering the quantity of gas delivered from the reservoir of coal gas works, and consists of two concentric hollow cylinders, divided into compartments in the intervening space by partitions in the direction of the radii. There are two apertures in each of these compartments at the angles diagonally opposite; one of which forms a communication between the inner cylinder and the outer one, and the other affords

a passage from the latter to an external air-tight vessel that encloses the whole, leaving sufficient space between them for the liquid-meter to turn freely round inside. A tube passes through the external case into the centre of the inner cylinder, of which it forms the support at the side it enters, and round which it revolves, the liquor being prevented from passing out between the tube and the end of the cylinder by a collar stuffed so as to prevent its transmission; a short fixed pivot passes at the opposite side from the external case to the centre of the other end of the cylinder, which has a thimble, or receptacle fixed to it there for its reception, which pivot forms the opposite support for the cylinder in its revolutions, the other being the tube, as already mentioned. Through this tube the liquor passes from the higher vessel into the inner cylinder, and from thence into the bottom of one compartment of these between it and the outer cylinder, in which as it rises it makes the cylinder revolve in proportion as its weight in that compartment exceeds the weight at the opposite side of the cylinder. The liquor proceeds in this manner in depressing that side of the cylinder, until the outer aperture from it into the case comes on a level with the top of a tube, that passes from one side of the case into the lower receiving vessel, at which time it begins to pass from the entering tube into the second compartment, and so on through all the compartments, as they successively are impelled round; the height of the top of the delivering pipe, where it enters the case, regulating the height at which the liquor will remain in the lowest compartment. It is to be noted here, that the patentee takes for granted that the air enclosed originally in the cylinder, and in the case, will remain in them unaltered, except in being reduced in bulk by the pressure of the liquor of the upper vessel, from which the liquor is transmitted; being aware that if there was no air enclosed, the liquor would pass without causing the cylinder to revolve.

The other form for the liquid-meter resembles an instrument, used for shifting the valves in some hydraulic engines, and consists of a trough open at both ends, with a partition across its middle; directly underneath which it is supported by two pivots, one at each side; and exactly over the line of these pivots, the pipe that comes from the upper vessel passes out over the middle of the partition, by which arrangement, as soon as the angular compartment, formed by the partition and one half of the trough, receives a certain measure of liquor, it outweighs the other half, falls down, until it is stopped by a bar placed to regulate the degree of its descent, and thereby shifts the position of the partition, so as to cause it to incline in the opposite direction, and bring its other side and the empty half of the trough, beneath the pipe from which the liquor is running. This other half of the trough in like manner falls down as soon as full, and causes the first half, which has been emptied in the mean time, to come beneath the pipe to be filled in its turn, and thus the two sides are made to act alternately as long as the liquor is delivered.

This apparatus is enclosed in an air-tight case, similar to that first mentioned, from the lower part of which a tube passes in like manner to the lower vessel.

Besides these parts described, wherein the two sorts of the apparatus are differently constructed, they have also machinery attached to them, or a species of clock work for giving motion to an index, which, by the arrangement of multiplying wheels well known, like those used in other registering instruments, points out the number of measures in the one case of the compartment, and in the other of the half-troughs which have been transmitted of the liquor through the apparatus.

In stopping either of the transmitting tubes by a cock, the liquid-meters cease to act, and again commence their operations on its being opened.

We are always really sorry when we are under the necessity of pointing out defects in the plans of ingenious patentees, which proper experiments, previous to the enrolment of their specifications, might have led them to avoid or remedy. The patentee will find on trial that the air enclosed in his liquid-meters, which he knows is essential to their operation, will be absorbed by the liquor in passing, and this in a greater proportion and more rapidly, as the pressure from the height of the upper vessel is greater. The liquid-meter will therefore, from this cause, after working some time, cease to give any motion to the index, and will let the liquor pass through without affording any indication of its transmission, and will continue in this state until again replenished with air.

Patent granted to William Harrington, *of Crosshaven, County of Cork, Esq. for an improved raft for transporting timber.* Dated June 15, 1824.

To form Mr. Harrington's raft, the keel, stem, and stern posts of a ship are to be put together in the usual manner, and on the keel floor timbers are to be laid across, and futtocks and frame timbers added to them, so as to form the frame (or skeleton) of a vessel; but, according to the draft, having the timbers farther apart than for a ship. These various parts are to be well bolted together, and then wale-pieces are to be fastened over the timbers from stem to stern, across which at proper intervals beams or long planks are to be laid, and secured to them by dove-tailed joints and other fastenings; the frame, according to the draft, will in this state be open at both ends, into which the balk or timber to be conveyed is to be introduced, and arranged fore and aft close together, so that at the stem and stern its ends may lie in the form suitable for those parts. In building up the balks proper intervals should be left for the masts, ends of the cable bits, and windlass bits, and other pieces that descend vertically into a vessel; or those pieces may be put up in

their proper places in the first instance, and the timber be built up about them. When the timber is thus packed up close to the beams or cross-ties, pieces should be laid across between these ties of the same thickness with them, so as to leave no interval unfilled in any part. Then another course of wale-pieces is to be fastened on the frames, at a due height above the former course, beams or tie-pieces to be laid across and dovetailed into them as before, and the balk to be then built up close to them from below in the manner already described. When this part is completed, a third course or streak of wale-pieces is to be fastened on above, at the level of the upper deck, and to be secured with beams and tie-pieces like the others; but in this upper part the balk is only to be built up at the forecastle and stern, and an interval left in the middle, in which is to be formed a place for lodging the sailors who are to navigate the raft, and for stowing the provisions and the tackle, for the construction of which place no adequate directions are given, farther than to state that planks are to be fastened outside in this part, and a deck to be formed above; but this can hardly be said to be peculiar to this part, as the whole of the upper part is elsewhere directed to be decked, as well as to be furnished with such posts, rails, and other parts, as are necessary for navigating a vessel, and are usual; and moreover the whole outside is directed to be planked over when the balk is built up inside.

When rough weather is expected, staples, cleats, and other fastenings, are advised to be used in building up the balks, to prevent their shifting their places over one another in the pitching of the raft; and it is also stated, that the whole may be farther secured by fastening hoops of iron, or of other materials, round the outside.

This invention does not appear to us a very economical mode of forming a raft. In fact the patentee, without appearing to be aware of it, has in reality directed a ship

to be formed outside his raft in building it up, having keel, stem and stern posts, floor timbers, foothooks, top timbers, planks, decks, &c. the same as another vessel; and when it is considered that this imperfect vessel must be broken up at the end of the voyage, it would most probably be found that the loss would more than counterbalance any saving, which might arise from the rough construction and unfinished state of its several parts.

It may frequently be desirable to effect the transport of large quantities of timber in one conveyance across the ocean, but for this purpose no part of the plan of the patentee appears adviseable to be adopted. Perhaps if a raft were formed in the shape of a punt, but much broader in proportion, with the layers of timber alternately crossing each other, and fastened together by bolt iron running between the pieces of timber, both vertically and across from side to side at certain intervals, and well secured by keys, or screws and nuts, to the outside pieces, so as to brace the whole firmly together, it might be navigated safely; while the whole of the iron work might be sent back after the voyage in a common vessel, to serve again for constructing another raft, without causing any loss but what the bolt holes in some of the outside pieces would occasion, in somewhat diminishing their value for some purposes, though for others they would be in no way injurious to them. This rough plan we could easily show to be feasible, but our limits will not at present allow us to enter into the detail.

The mode for lodging the crew, and finding stowage for necessaries for the voyage, proposed by the patentee, as we have before stated, appears deficient; but probably if a small sloop, or other vessel, were built up in the centre of the raft, it would answer this purpose much better, and serve afterwards to take back the sailors at least to the port from whence they sailed, if not large enough to carry along with them the iron work of the raft abovementioned, when used with one of this construction.

Patent granted to JOHN HEATHCOAT, *of Tiverton, Devonshire, Lace-manufacturer, for an improved mode of producing figures or ornaments in or upon a certain description or kind of goods, manufactured from silk, cotton, flax, or other thread or yarn.* Dated February 26, 1825.

THE object of this patent is the use and application of purl in making figures and ornaments on lace.

In the first of three methods for the above purpose, which are described in the specification, it is directed that designs of figures or ornaments, such as sprigs, bouquets, &c. be traced on the lace, previously stretched in a frame, after which the purl is to be taken, with which article it is asserted all lace-manufacturers are well acquainted, and one end of it is to be applied to one of the said figures or ornaments, and to be sewed or otherwise fastened to the lace, according to its outline and frame, and then successively to the other figures, in the same manner.

In the second method the figures are to be traced on a cushion, and the purl to be then pinned on it, according to their form; after which the lace is to be laid down on the cushion, and the figures so formed with the purl to be sewed on it, and then to be detached from the cushion.

In the third and last method, the figures or ornaments are to be traced upon paper, over which the purl is to be pinned, so as to represent their form, and then to be sewed to itself so as to preserve that form afterwards. The figures thus produced are then to be detached from the paper, and may be sold by themselves separately, to serve as a substitute for Brussels sprigs in ornamenting lace.

We understand there is a considerable demand for Brussels sprigs. If, therefore, the article last mentioned in the specification can be made equal in beauty to the Brussels sprigs, or even sufficiently approaching to them in appearance so as to come at all in competition with them, it is evident that this circumstance will make the patent proportionably valuable.

FRENCH PATENTS.

An Account of Inventions for which Patents, or BREVET D'INVENTIONS, *have been obtained in France, and which are now expired.*

Brevet d'Invention for five years, granted to M. BRICE MAIZIERRE, *mechanist, Rouen, for a method of saving many horses employed in mills, by applying to the axle of the lantern wheel, which is put in motion by the horse wheel, a fly with four arms, each carrying a heavy weight.*

THIS brevet requires no explanation farther than what is given in the title; we have, however, to observe, that the contrivance is of ancient date, as a fly of the same sort, for the same purpose, and having four arms also, is described in the 2d Vol. of Desaguilier's Experimental Philosophy, published in 1763, as being used in Vauloüe's horse engine for driving piles.

Brevet d'Invention for fifteen years, granted to M. J B. MOLLERAT, *for a process for extracting soda from sulphate of soda.* Dated June 27, 1806.

DISSOLVE lime or calcareous matter in pyrolignous acid, either cold or hot; the liquor will then become covered with a vegetable oil, which this material contains, and which may be separated from it by mechanical means; dissolve, then, in the liquor thus saturated with lime, a quantity of sulphate of soda, to be determined by the degree which the calcareous solution will indicate by the areometer for salts.

By this process the sulphuric acid quits the soda, and forms with the lime a solid salt, which precipitates to the bottom of the vessel that contains them.

The liquor which lies above the sulphate of soda, evaporated and crystallized, will yield acetite of soda, if it is wished to collect that salt; or if it is dried and burned, either on the floor of a reverberating furnace, or on the grate in the front of a furnace prepared for that purpose, it will give carbonate of soda, of which a hot lee will form crystals of the greatest purity by refrigeration.

Brevet d'Invention for ten years, granted to M. Burette, *Paris, for making bricks (or square lumps) of fossil coal, of charcoal of wood, and of charcoal of turf, without the use of a cement of clay.* Dated June 12, 1811.

The method of performing this consists in mixing the combustibles mentioned, reduced to a state of powder, with a glutinous substance, whether animal or vegetable, the price of which is as low as possible. M. Burette states that he makes use of residues of common glue, of glutinous pastes made of flour, and of those produced by lichens and mosses, and generally of all other substances, except the earths, which have sufficient tenacity to re-unite the said coal or charcoal, in a solid form.

The proportion of the glutinous matter which is to be employed, cannot be precisely determined, on account of its greater or less tenacity; but a certain rule for ascertaining this is to make the mixture so that the coal or charcoal powder may have sufficient consistence, when it is converted into the bricks (or lumps). A simple trial with a small quantity of the materials, will soon show the proper proportions of the mixture.

With regard to the form of the bricks, that in common use (for building bricks) should be used.

Brevet d'Invention for five years, granted to MM. Amavet, *and* Belleville, *of Paris, for a wheel with moveable flash boards.* Dated April 28, 1816.

This wheel, made of wood, is composed of an arbor or axle of an octagonal shape, having eight frames projecting from it, on which are fastened by hinges the moveable flash boards, independent of each other.

This arrangement causes the flash boards, or impellers, which are about to pass out of the water, to be always in a vertical position, which prevents them from carrying up any weight of water with them, and from counteracting in any manner the effect of the other flash boards, which present their surfaces to the action of the current.

Brevet d'Invention for five years, granted to M. CHARLES, *cutler, at Paris, for making razors with* metallic backs, *and with blades which may be changed.* Dated February 27, 1817.

THE backs of these razors are made full in all their proportions, and yield to the file; they are grooved the whole length of the blade, by a cutting wheel put on a lathe, and are polished by a buff wheel, mounted also on a lathe; the upper extremity of each is pierced with a hole, which receives a screw to which the blade is hooked.

The blade, which is of cast steel, is forged flat, and filed on a mould, which corresponds exactly with the groove in the back; it is then tempered, and afterwards whetted to finish it.

This blade has at its back, near its upper extremity, a small oblique cavity, which forms a hook, by which it is hooked to the small screw of the back. The lower extremity of the blade forms a re-entering angle, which rides over the prolongation of the back at the place where the groove terminates.

When the blade is thus fitted in the groove of the back, the screw is turned till it draws together the two sides of the back sufficiently to prevent the blade from moving in any direction.

To take off the blade, it is only necessary to turn back the screw that keeps it in its place.

Brevet d'Invention for five years, granted to M. CHENEAUX, *of Paris, for a new strap for whetting razors.* Dated July 12, 1816.

MANNER OF PREPARING THE STRAP.

TAKE a piece of common leather, leave it to soak in warm water, and then rub it over with a matter composed of the filings of cast steel dissolved in aquafortis, made red hot in a crucible, and pounded to reduce it to powder.

This meagre composition, of a red colour, without any sort of mixture with oil or grease, will make the strap different from all those hitherto manufactured, and cause it to produce an edge preferable to that given by the hone or the polisher.

The Operative Mechanic, and British Mechanist, *being a practical display of the Manufactories and Mechanical Arts of the United Kingdom.* By John Nicholson, Esq. *Civil Engineer.* 8vo. pp. 796. Knight and Lacey, 1825.

This work, as stated by its author in the preface, is designed as a companion to the workshop. Its contents, besides some elementary matter on the mechanical power, &c. with which it commences, consist of explanations and accounts of mill-geering, water-mills, wind-mills, steam-engines, hydraulic engines, accessory machines, manufacture of metals, manufactures of fibrous materials, various mills used in manufactures, &c.; pottery, horology, building (divided into eleven heads), rail-roads, and locomotive engines; with an appendix, containing practical geometry, mensuration, useful receipts, and a glossary.

This compilation is in most respects well executed, the descriptions plain and intelligible, and the selections for the most part interesting and useful, and such as do credit to the industry and attention of the author; and on the whole it is a very respectable performance, which would serve well as a book of reference to masters and employers, and to gentlemen out of trade, who must occasionally direct workmen on their estates, and to those who on any other account are desirous of the variety of useful information which it contains, as well as to those for whom it was intended; though to those latter not so much as the author may imagine.

After saying this much in its favour, the author will, we hope, excuse a few words of advice, which we shall offer chiefly with a view to the improvement of the next edition. It is obvious that where so many articles claim to be inserted, brevity must be studied; but if a few additional pages would make a book more complete, we think neither author nor proprietor would be inclined to omit them, if convinced of their utility.

The very interesting subject of bridges has been entirely omitted, to which, including some notice of those

on the suspension principle lately erected, a page or two might have been advantageously devoted, with a few lines on the catenary curve; or at least the method of describing it should be added to those of the other curves most in use.

The very good collection of hydraulic engines would be made more complete by an account of Godwin's engine; of two or three from Ramelli and M. Serviere; and of Gwyn's patent engine; the figures of which are given in the 23d plate of Young's Nat. Phil. under the numbers 313, 314, 315, 316, and 317.

Several small inaccuracies in the plates require correction, though the general execution of them is very creditable to the engraver; they should be all carefully looked over, and compared again with the letters of reference, as in several instances these are not to be found in the figures, as in the case of Bonnard's wooden piston; several typographical errors also require correction. The index is not by any means full enough for the work, nor is the glossary as correct as could be desired.

Some few parts in the elementary portion we could wish to see more perfect; of which we shall instance the article on friction, on which subject, so important to mechanism, only twenty lines are given, and those by no means satisfactory.

In a few instances the author has evidently been led away by the forced and artificial celebrity, or rather publicity, of some new contrivances, which are not sanctioned sufficiently by experience, or satisfactory proof, to merit the eulogiums he has unwarily bestowed on them; of those, the most conspicuous is the machine commonly called Brown's vacuum engine, but in reality the invention of the Rev. Mr. Cecil, as explained in a paper respecting it in our Number for August last, in which is also pointed out the powers and defects of the contrivance, and its liability to cause explosion.

Next, after describing Palmer's single rail-way, the author states that "*this arrangement certainly seems to ensure the grand principle of lessening friction*;" an asser-

tion originating with the inventor, and copied from one ephemeral publication into another without consideration, a proceeding which such a work as the present surely ought not to imitate; but, if we are mistaken, and the author really on mature reflection is still of this opinion, we should be glad to have his reasons as an engineer stated for this assertion, and some fair proof given in support of it, of which as yet we have not seen the slightest appearance in any of the many accounts which have appeared respecting this rail-way. Thirdly, the praises of Messrs. Taylor and Martineau's steam-engine, and the high opinion which the author evinces to have of it, by selecting a draft of it for his frontispiece, do not seem judicious. The engine, as to its execution and workmanship, may have its merit; but the author ought to have known the radical defect of all horizontal steam-engines sufficiently, not to commit himself by so public an approbation of them. This great defect, which consists in the inequality of the friction of the piston on the main cylinder, that must in a short time totally destroy the figure of the latter, has been attempted to be remedied in one of a similar species, now used at the tunnel at Rotherhithe, by connecting an arm to the cross-piece to which the piston rod is attached, which arm runs in the same direction of this rod, and parallel to it, and is supported by a roller at its farther extremity, that moves on a bar, fixed purposely to sustain it; this from being at the side of the piston instead of directly over it, as it ought to be, adds to the friction by the twist which it gives to the frame of which it forms a part, so as perhaps to do some mischief; but even if fixed in the best manner, unless in very small engines, where the weight of the piston must be trifling, we think it could hardly act sufficiently well to put engines of this sort on a par with those which have vertical cylinders, though certainly the idea of this improvement is judicious, and will prevent a great part of the injury caused by the inclination of the cylinders. It is true that the engine at the tunnel is not pre-

cisely an horizontal engine, as each of its cylinders is placed so as to form an angle of 45° with the horison; but, proportionally as the cylinder deviates from the perpendicular, it is obvious that it must more or less be liable to the injury stated, and so far be defective.

The corrections and improvements which we have suggested for a future edition, would require but a very few pages; but there are other articles which ought to be added to it, to render the work complete, that would perhaps increase its bulk a good deal. We allude to accounts of those manufactures and arts, of which no notice whatsoever has been taken in it, though apparently as deserving of it as some of those which have attained a liberal share of attention, of which we shall only mention the machinery used in the stocking business, and that in the lace manufacture; the latter of which is peculiarly curious and worthy of notice as a mechanical lesson, and both are manufactures of importance, in which great numbers of workmen are employed. We are aware that the limits to which a work of this kind must necessarily be restrained, may be urged as an excuse for their omission; but we think it obvious that where it is necessary a work should not exceed a certain number of pages, that the design of it should be equally limited, to prevent its being an arbitrary selection out of many subjects equally comprised in the design, but impossible to be brought within the bounds prescribed. Indeed, were works to be published of which the advantage to workmen was to be really the chief object, we are inclined to think they had much better consist of single treatises upon the matters most necessary for each separate trade, than of collections treating of a great many trades and manufactures, and where of course the greatest part must be of little moment to those of any single calling. Treatises of this kind, with a few on those elementary parts of science in which most trades are interested, would form the *best companions for the workshop*, as every workman would then purchase that part which best suited him, without being obliged to lay out his money

for what did not concern him, in order to get at that which was immediately applicable to his own business.

But taking the book as it really is, without limiting it, as the author has done, to the use of a peculiar class, we think very well of it, and have now only to add, that from the many useful tables inserted in it, and the general information which it contains, we know of no more useful publication as a work of reference on the many subjects of which it treats, that can be purchased for more than three times its present price of thirty shillings.

LIST OF NEW PATENTS.

William Duesbury, of Boasal, Derbyshire, colour manufacturer, for a mode of preparing or manufacturing of a white, from the impure native sulphate of barytes.—Dated September 29, 1825.—Six months to enrol specification.

John Martineau, the younger, of the City Road, Middlesex, engineer, and Henry William Smith, of Lawrence Pountney Place, in the city of London, Esq. for improvements in the manufacture of steel. Communicated to them by a foreigner.—Dated October 6, 1825.—Six months to enrol specification.

Sir George Cayley, of Brompton, Yorkshire, Bart. for a new locomotive apparatus.—Dated October 6, 1825. Two months to enrol specification.

James Shudi Broadwood, of Great Pultney-street, Middlesex, pianoforte maker, for improvements in small, or what are commonly called square pianofortes.—Dated October 6, 1825.—Six months to enrol specification.

Thomas Howard, of New Broad-street, London, merchant, for a vapour engine.—Dated October 13, 1825.—Six months to enrol specification.

Nathaniel Kimball, of New York, merchant, for a process of converting iron into steel. Communicated to him by a foreigner.—Dated October 13, 1825.—Six months to enrol specification.

Benjamin Saunders, of Bromsgrove, Worcestershire, button manufacturer, for improvements in constructing or making of buttons.—Dated October 13, 1825.—Six months to enrol specification.

Thomas Dwyer, of Lower Ridge-street, Dublin, silk manufacturer, for improvements in the manufacture of buttons.—Dated October 13, 1825.—Six months to enrol specification.

Joseph Clisild Daniell, of Stoke, Wilts, clothier, for improvements in machinery applicable to the weaving of woollen cloth.—Dated October 13, 1825.—Six months to enrol specification.

Josiah Easton, of Braford, Somersetshire, Esq. for improvements in locomotive or steam carriages; and also in the manner of constructing the roads or ways for the same to travel over.—Dated October 13, 1825.—Six months to enrol specification.

William Hirst, John Wood, and John Rogerson, of Leeds, for improvements in machinery for raising and dressing of cloth.—Dated October 21, 1825.—Six months to enrol specification.

Ralph Stephen Pemberton, and John Morgan, of Lanelly, Carmarthenshire, for a consolidated or combined drawing and forcing pump.—Dated October 21, 1825.—Two months to enrol specification.

Goldsworthy Gurney, of Argyle-street, Middlesex, surgeon, for improvements in the apparatus for raising or generating steam.—Dated October 21, 1825.—Six months to enrol specification.

Lemuel Wellman Wright, of Princes-street, Lambeth, Surrey, engineer, for improvements in the construction of steam-engines.—Dated October 21, 1825.—Six months to enrol specification.

Henry Constantine Jennings, of Devonshire-street, Middlesex, practical chemist, for improvements in the process of refining sugar.—Dated October 22, 1825. Six months to enrol specification.

THE REPERTORY OF PATENT INVENTIONS, &c.

No. VI. DECEMBER, 1825.

Specification of the Patent granted to WILLIAM GILMAN, *of Whitechapel Road, Middlesex, Engineer, and* JAMES WILLIAM SOWERBY, *of Birchin Lane, London, Merchant, for certain improvements in generating steam, and on engines to be worked by steam or other elastic fluids.* Dated April 13, 1825.

WITH A PLATE.

TO all to whom these presents shall come, &c. &c. *Now know ye,* that in compliance with the said proviso, we, the said William Gilman and James William Sowerby, do hereby declare that the nature of our said invention, and the manner in which our said improvements are to be performed and carried into effect, are set forth and explained in and by the sheet of drawings hereunto annexed, and by the following description thereof, (that is to say): Our improvement for generating or producing steam consists in placing one or more cylindrical boilers, B B, horizontally over the fire place, C, of our furnace, as seen in the sections, figs. 2 and 3, (Pl. XII.) within which boilers are shafts or axles, *d d d d,* running through their whole length, which shafts have leaves or paddles attached to them; and being connected together by the cross shaft and bevelled geering, shown in fig. 1, they form agitators.

These agitators are caused to revolve within the said boilers by the engine, or other adequate means, with sufficient velocity to give motion to the water injected into the said boilers, for the purpose of being converted into steam, by which means, and the assistance of its centrifugal force, the said water is spread in an extremely thin sheet over the whole internal surface of the metal whereof such boilers are made, and by the said leaves being fixed obliquely, or at an angle with the shafts or axles, the water is thereby carried or worked forward from the ends, at which it is injected to the other ends of the said boilers. Or this carrying or working forwards of the injected water may be effected by its own gravity (and without obliquity in the leaves) if the boilers are fixed in duly inclined positions, and the water be injected at their upper ends. The water may, with the use of horizontal boilers, be injected at either end, and the steam be taken out at the same or contrary end of either of the boilers, as convenience may suit. The agitators are either used simply as above described, or with concentric cylinders of thin copper or other suitable metal, fixed on their arms, as shown by the dotted lines in the sections, figs. 2 and 3, and they have the leaves or paddles attached to their circumference. The object of this arrangement is to prevent the water from being carried with the steam into the steam pipe, P, of the engine. And in order to prevent the agitation of the water in boilers used for generating steam on board of boats or vessels, or in carriages to be propelled thereby, from interrupting or rendering irregular the generating or supplying of steam to the engine, we sometimes provide a steam chamber, separated from the upper part of such boiler by a valve or valves, opening into such chamber. These aforesaid concentric cylinders, (or cones, if the fancy of the engineer should lead him to make the ends of different diameters) being mounted within the boilers, admit the steam through the numerous minute holes with which their whole surface is pierced, with the exception

of a strip or line, about two inches wide, immediately adjoining and running parallel with the face of each leaf or paddle, which unpierced strip supports and assists in carrying the newly injected water whilst it is acquiring the necessary momentum, and is spread on the internal surfaces of the boilers, and is being heated. The steam, after passing through these minute holes into the insides of the revolving internal cylinders, flows through the steam connecting pipes, R, figs. 1 and 2, which pipes are curved so as to project within the boiler as far as the arms of the agitators will permit, whereby the steam flowing to the working cylinder of the engine (instead of sweeping the sides when the boilers are small, and carrying with it a portion of the water), is compelled, as fast as such steam is produced, to pass through the minute holes in the revolving cylinders at right angles, by which that effect is avoided. The tiers of tubing or pipes, No. 1, 2, 3, 4, sections, figs. 2 and 3, are traversed by the water destined to supply the boilers, length by length, in every tier successively, from No. 1 to No. 4; and the said water likewise passes through those other pipes that line the fire place on each side, previous to the entrance of such water (when considerably heated) into the chambers of the transfer pumps, I I, fig. 1. The forcing pumps, F F, fig. 1, inject the cold or new supply of water: G is the cold water reservoir: H the suction tube: N N the injection pipe connected at N, figs. 2 and 3, with the first tube or pipe in the upper tier. The transfer forcing pumps, I I, receive the heated water by the pipe, K, connected to the last tube or pipe, K, fig. 3, of the system of such pipes, lining the fire place, from the chambers of which pump the said water is forced through the pipe, L L L L L, figs. 1 and 2, into the boilers; and when there, is carried or worked forward by the agitators in the manner as before stated. The arrangement of these pumps is such, that on their being put in motion (by any of the usual methods), a certain quantity of cold water, proportionate to the bore

and length of stroke, will be injected by one of the pumps, F, into the upper tier of tubeing, and during the same time an equal supply of the heated water will be obtained in the chamber of the transfer pump, I, which is connected therewith, and vice versa. Hence, the tubeing is kept continually full, whilst security is obtained by a safety valve on the pipe, N, fig. 1, as shown therein. These forcing pumps and the reservoir may be placed in any convenient station, their situation being quite immaterial. In another modification of the apparatus for producing steam as above described, the transfer forcing pumps, I I, fig. 1, are not employed; but the water is allowed to flow to the boilers from the tubeing or pipes, extending between N and K, and through the pipe, L, which last pipe is in this case directly connected to the pipe, K; the short branch, tubes, or pipes, that connect the pipe, L, with the boilers, are sometimes extended in length sufficiently for each to have a stop cock introduced thereon, by which the size of the passages, and consequently the supply of water, may be regulated. The deposited matters previously held by the water, suspended, or partly in solution, and the superfluous water, are carried forward by the agitators, and received by the tube or pipe, O, fig. 2, and are conducted by the tube, S, figs. 1 and 2, and occasionally admitted through the cock, No. 1. The passage of this cock is then closed, and the cock, No. 2, immediately opened, when the fluid contents between the cocks will be discharged, and steam supply its place. These cocks are to be opened and shut by the engine in any of the usual methods, and the boilers, without the aid of the engine man, are thereby kept clean, and the superfluous water discharged into a close vessel, E, and the steam that will separate from it is conducted through the dotted tube, shown in fig. 1, into the reservoir of cold water, G, where it is condensed, and its heat saved. The quantity of water injected is to be regulated according to the superfluous water discharged through O, by shifting

the coupling rod that works the lever, T, of the said pumps, F F, and I I, into one or other of the pin holes provided in such lever. The connecting pipes between the boilers, as also the steam pipe, P, and the injection water pipe, L, form simple passages, as the drawings exhibit; or as they may have valves opening upwards, whilst the pipes, O, have their valves opening downwards, by which arrangement, in case of accident from the bursting of one boiler, the steam in the other is secured. In the first case, the passage of the water to the boilers is permitted without regulators; in the second case, the valves form regulators from their lift or degree of opening being extended or contracted, as the case may require, which is effected by the action of the screw, A, fig. 7; but when valves are not used, cocks are introduced for that purpose, if found desirable; and the steam pipes, P, should be furnished with a capacious and well constructed safety valve. These boilers should be made of scrap iron, without joint or rivets, with the exception of the end at which the agitators are introduced, and may be lined and coated, or not, with copper or other metal, to prevent corrosion. They may be used in any number, in the manner above shown, receiving their supply of water either after it has traversed the system of heating tubes (No. 1 to 5), or else directly by the forcing pumps from the reservoir, G. Another form of arranging the boiler, B, and tubeing, Nos. 1, 2, 3, and 4, is effected by placing the cylindrical boilers across or transversely to the furnace, and the tiers of tubeing or pipes likewise in the same direction, instead of lengthways of the fire-place, C, as we have shown by the figs. 2 and 3; but that part of the system of tubes or pipes which lines the sides of the fire place, should be continued in the longitudinal position, as described in the figures. In case of using transverse boilers and tubeing, the ends of the boilers, with the steam and water pipes, together with the shafts, *d*, and bevelled geering, which gives motion to the agitators, as seen in fig. 1, will,

instead of projecting over the fire doors, at the end of the furnace, C, be ranged along the side of the furnace, and therefore out of the way of the person tending the fire. The contrary ends of the cylindrical boilers, B, will be supported by, and either project or not through, the other side of the furnace, sufficiently for the vertical tube or pipe, O, fig. 2, to be attached to them, either on the outside, or else within the furnace, or within the thickness of its walls, as occasion may require. The tiers of tubeing or pipes may be ranged across or transversely to the fire place, whether the boilers are in the same direction, or are placed longitudinally, with respect to such fire place; and the ends of such tubeing or pipes may be supported withinside the casing or walls which form the external parts of the flues and furnace, such casing or walls being composed of brick work, metal, or any other fit material; or the ends of such tubeing or pipes may be allowed to project through the sides of the furnace, so as to admit all the conical joints, (as shown in fig. 5, hereinafter to be described) to be in view; and likewise the connecting tubes or pipes, 5, 5, figs. 2 and 3, that form the passages from tier to tier respectively, so as to permit of adjustment when requisite. The ends of the tubes or pipes are represented in the drawing as being closed; but one or both ends of each of them, if desirable, may be secured with a screw plug, which can be taken out at pleasure, to allow the tubes or pipes to be cleared from time to time of any sediment or incrustations which may be deposited in them. We do not confine ourselves wholly to using these cylindrical boilers with agitators, but we sometimes apply them without agitators, filling them half, or any other fit degree of fulness, and cause them to receive their supply of water from the tubeing, as before-mentioned, or otherwise; and we sometimes arrange such cylindrical boilers in more than one tier, as circumstances may require. In either case they become much more effectual in the production of high or of low steam, than the immense boilers

or magazines now in use, though our improved boilers seldom exceed twenty inches in diameter for low steam, and decrease from that to ten inches, or under, in proportion to the height or strength of the steam required to be generated; and hence they are not only rendered far more secure, but require much less room than the boilers now in use. The tiers of boilers and tubes or pipes, Nos. 1, 2, 3, 4, as shown by the sections, figs. 2 and 3, form the bottoms and tops of flues successively, which flues are very shallow in depth, and are floored with fire clay or loam, or any other fit material, and they extend the whole width of the furnaces, whereby the hot air and vapours are thereby spread, and the caloric is much more effectually taken up by the water than if conducted in a square volume, more especially as the water contained in each tier of pipes upwards decreases in heat, as they approach the place, N, of injecting the new supply; and the diminishing heat of the volume of air and vapours in their passage from the fire through the flues being then brought nearly in contact with water, proportionally increasing in coldness, such air and vapours continue to give out their heat to the said water until their final discharge into the chimney, U. Fig. 4 is an horizontal section through the centres of a tier of tubes or pipes, and shows the manner in which the tubes or pipes are connected together. Both ends of each tube are closed, and a conical hole bored in the contrary side at each end, in which holes are fitted hollow double cones, that form the passages between each pair of ends. These cones are made of copper, or other suitable metals, and being ground into their holes or seats, render the joints completely tight. Fig. 5 shows one end of a tier of tubes or pipes, and exhibits the method of securing these conical joints: B is an oblong square, formed of any suitable metal, of any desirable thickness and width, having the strong screw, D, tapped into the end. After the ends of a tier of tubes have been introduced into the opening of the frame, having

alternately the hollow double cones, and the curved blocks, *a a*, properly adjusted between the tubes, as seen in the figure, this one screw will be fully equal to the forcing and retaining of the whole of the cones in their places. For increasing the effects of the coals, wood, or other ordinary fuel, used in generating steam in boilers on board boats or vessels, or in carriages, to be propelled thereby, we sometimes mix with, add to, or sprinkle upon the said fuel, either tar, pitch, or any resinous or inflammable substances, either mineral or vegetable. To elucidate the principle on which our engines act for employing the power of steam operating expansively, we refer to fig. 6, which may be supposed to represent a cylinder, 27 feet high, and one inch area in the bore. On the left hand is written the number of feet, commencing at the bottom; and opposite, on the right, are the comparative degrees of power that steam, of 500 lbs., presses on each square inch, is capable of exerting at each expansion, (taking the contractions and expansions of steam by variations of pressure in the same ratio as those of air). Now suppose the first foot to be filled with steam of 500 lbs. per inch, and that no more steam be allowed to enter, the result would be that it will expand and lift the piston until it fills the whole cylinder in a decreasing ratio of power, as shown by the figures on the right. These figures, added together, produce the aggregate amount of 1939 pounds weight, which one foot of such steam, by its expansive action, is capable of lifting one foot high; but it is manifest that so applying high steam in one cylinder is not useful to practicable purposes, because of the very great difference in its mechanical force when near to the commencement, and when near to the termination of the stroke of the piston. Therefore, to obviate this, and partly equalize the power, we add two or more cylinders, as the case may require, increasing and apportioning the area of each succeeding cylinder to the diminishing power of the steam. Thus, if a non-condensing high pressure

Fig. 1.

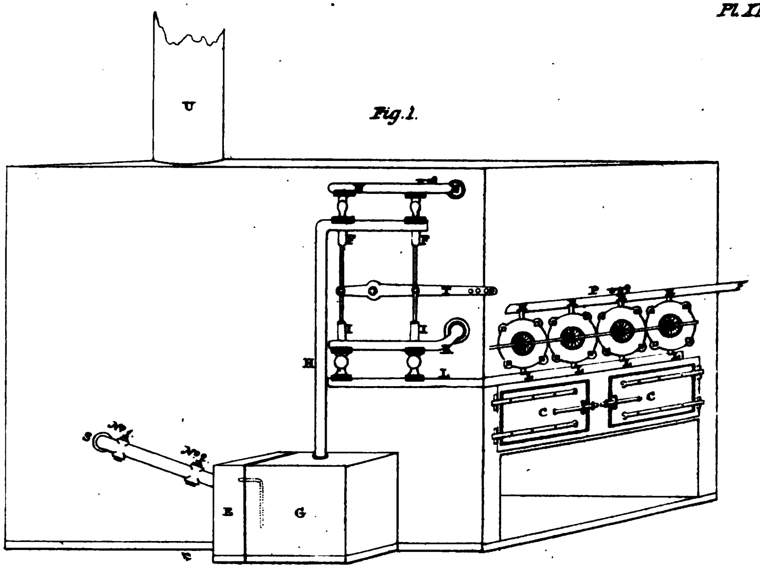


Fig. 6.

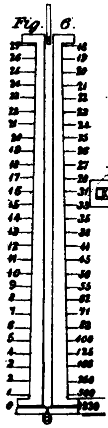


Fig. 4.

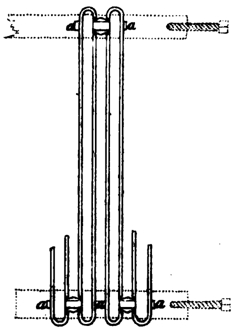


Fig. 5.

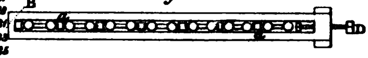


Fig. 2.

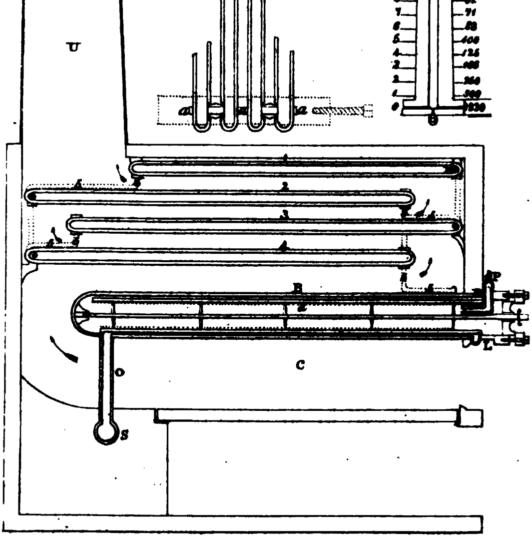


Fig. 7.

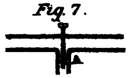
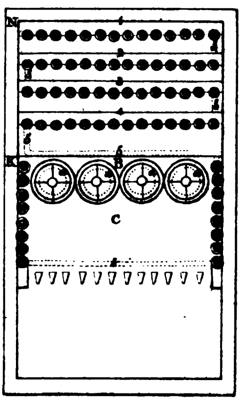


Fig. 3.



engine, with two cylinders, be required, allowing the waste steam to escape into the atmosphere, or otherwise employing it, we fill the first cylinder in part only, or else wholly, from the boilers, until the piston in the first cylinder has reached its limit, according to the strength or power at which it is intended to generate the steam; and when the piston in the first cylinder has reached its limit, according to the strength or power at which it is intended to generate the steam, and when the piston in the first cylinder has performed its stroke, a communication is then opened between that and the second cylinder, against the piston of which it acts expansively. The first cylinder having become, as it were, a steam chamber to the second, these two pistons may either, 1st, move together in the same direction, or else, 2d, they may move in contrary directions. In the first case, viz. when the two pistons move simultaneously in the same direction, the steam from the boilers is admitted above the piston in the first cylinder, and presses on its top, whilst the steam beneath this piston (which was admitted from the boilers in the previous ascending stroke), from its expansive power passes through a communication then opened to the upper side of the piston in the second cylinder, which it presses downwards at the same time, in conjunction with the first piston, and vice versa. In the second case, viz. when the pistons at the same time are one going down and the other up, the steam from the boilers is acting upon the top of the first piston, whilst the steam (previously admitted) beneath this piston is expanding against the under side of the second piston, and pressing it upwards. This decreases the resistance (as in the above-mentioned case) on the under side of the first piston, and occasions it to be carried downwards at the same time by the steam flowing from the boilers, and vice versa. In the foregoing descriptions of the expansive use of high steam in two cylinders, without condensing the first half of a complete stroke (up and down, or down and up), or so much of the

operations connected with a complete stroke by the piston, are detailed as are common to a single acting engine, and also to a double acting engine; and by the phrase vice versa, as used above, the reversed operations in the last half of a complete stroke, necessary for completing a double acting stroke, are intended. But when, instead thereof, a single acting stroke is required, then, at the end of the first half of a complete stroke (that is, when the piston was either gone up or down, but not returned), the connections with the boilers, and also with the atmosphere, are to be cut off, and other communications are at the same moment to be opened between the top and the bottom of each cylinder respectively, in order that the descent of the counter weight (whether this consists of pump rods or any other lead), on the opposite end of the beam, may displace the steam in each cylinder, and cause it to occupy the opposite ends thereof, ready for repeating the operations already described. As a further improvement on engines to be wrought by steam, we attach a forcing pump or pumps to the boiler or boilers, or to the steam pipes, or any chambers connected with the boiler or boilers, for the purpose of frequently proving their strength, by forcing water into all or either of them, until the water lifts a safety valve or valves, loaded in any requisite degree.

In the drawings hereunto annexed, and in the foregoing descriptions, we have shown and described several parts and things, which are already known and in use, respecting which parts and things, singly and apart, we lay no claim of invention or exclusive use, but only as such parts and things are or may be combined and applied for carrying our said invention into effect, in the manner hereinbefore described.

And we do hereby expressly ascertain and limit our claims under the hereinbefore in part recited patent, to the following particulars, (that is to say) :—First, we claim the principle of spreading thin sheets of water, by means of revolving agitators, over the internal surfaces of cylindrical

boilers, when placed horizontally, or but moderately inclined, in the modes hereinbefore described. Secondly, we claim the particular arrangements of the tube lined fire place and flues, which are shown in figures 1, 2, and 3, and described herein, with their several modifications that are mentioned, for the purpose of heating the water, previously to its being introduced into our boilers. Thirdly, we claim the mode of connecting and joining together our tubes or pipes in each of the tiers, which is shown in figures 4 and 5, and described herein. Fourthly, we claim the having of a forcing pump or pumps constantly attached to the boilers, or steam pipes, or chambers, for the purpose of readily proving their strength on all necessary occasions. Fifth, we claim the applying of tar or pitch, either mineral or vegetable, to increase the inflammability, and perfect the combustion of ordinary fuel used for the generating of steam. And sixth, we claim the principle of using high steam in two or more steam engine cylinders without condensing (to assist our engine by the vacuum formed thereby), in the manner hereinbefore described.

In witness whereof, &c.

Specification of the Patent granted to CHARLES CHUBB, *of Portsea, in the county of Southampton, Ironmonger, for an improvement in the construction of locks.* Dated June 15, 1824.

WITH AN ENGRAVING.

TO all to whom these presents shall come, &c. *Now know ye*, that in compliance with the said proviso, I, the said Charles Chubb, do hereby declare that the nature of the said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the drawings which are hereunto annexed, and by the following description thereof, (that is to say): My said improvement in the construction of locks is ap-

plicable only to that description of locks generally known under the denomination of Chubb's Patent Detector Lock, and for which letters patent were granted to Jeremiah Chubb, of Portsea, bearing date at Westminster on or about the third day of February, in the fifty-eighth year of the reign of his late Majesty, King George the Third, and in the year of our Lord one thousand eight hundred and eighteen;* and in order that the application of my said improvement may be distinctly understood, I will first briefly describe one of the said patent detector locks, furnished with what the patentee denominated detecting mechanism. The detector is a detent or lever, moving upon a fixed centre pin, being formed with a hook or catch, adapted to interlock with a notch or stud in the bolt of the lock, so as effectually to stop and resist the motion of such bolt, whenever the detector is moved on its centre pin so as to come into contact with the bolt; but if the detector is moved on its centre pin so as to be clear of the bolt, it will then make no opposition to its motion. The detector spring is a spring applied to the detector in such a manner as to urge its hook or catch towards the bolt, when the detector is moved, so as to bring the said hook or catch nearer to the bolt than a certain position which may be called the point of detection; at the same time the said detector spring will urge the detector hook away from the bolt, whenever the same is at a greater distance from the bolt than the said point of detection. The detector is so placed as to be operated upon by the tumblers of the lock when the whole or any of them are raised; and if any of the tumblers is raised too high, (that is to say,) is moved further from the centre of motion of the key than the required position in which the notch in such tumbler comes opposite to the stud of the main bolt (in order that the main bolt may pass to open the lock), then such tumbler which has been too much raised will move the detector beyond or within the point of detection, in which case the detector spring will

* See Repertory, Second Series, Vol. xxxiv. p. 321.

throw the hook of the detector into contact with the bolt, and the detector will thereby effectually stop any motion of the bolt, even though the tumbler which occasioned the detection should be restored to its proper position. For though any one of the tumblers which may be raised too high will operate against the detector to throw its hook into the notch in the bolt, yet there is no connexion between such tumbler and the detector, which can occasion the detector to leave its then position. As the true key of the lock will raise each tumbler to its required position, and no further, it will never throw the detector beyond or within the point of detection; consequently, the detector spring will always keep the detector hook disengaged from the bolt; but if a false key or a picklock be employed to raise the tumblers, there will be every probability that some one will be raised too high, and will move the detector beyond the point of detection, so that the detector spring will then throw the hook into contact with the bolt. In this state the lock is what is called detected, and the possession of the true key has evidence that an attempt has been made to violate the lock, because the said true key will not now open it; for neither the true key or tumblers have any means of communication with the detector after it has passed within the point of detection. The remaining parts of the detecting mechanism are for the purpose of regulating the lock, or releasing its bolt from the hook of the detector. They are as follows:—The regulating bolt is a slider within the lock adapted to operate upon the detector in such manner as to raise or remove the hook thereof away from the bolt of the lock beyond the point of detection, and it is operated upon by an adjusting instrument, which is called the regulating key, which may be similar in form to other keys, but so made as not to open the lock, it being designed only to discharge the detector, and regulate the lock, by restoring its parts to such a state of adjustment that its own key will open it. For this purpose the regu-

lating key has a different arrangement of the steps on its bit, one of which shifts or moves the regulating bolt. The regulating bolt may be placed over or under the bolt of the lock, and has a pin or stud which projects from it, and applies against the tumblers of the lock, which are adapted to resist the motion of this regulating bolt, unless each one of the said tumblers is raised or moved into a given position, and neither more or less, by means of the several steps in the bit of the regulating key. The regulating key being applied in its place in the lock, and turned partly round, its several steps will first raise each tumbler to its exact required position, and then it will move the regulating bolt, by which means the detector will be moved without or beyond the point of detection, and the detector spring will throw the hook of the detector out of the reach of the bolt, which may be effected by a small inclined plane or wedge upon the regulating bolt. By this means the lock will be regulated or restored to its original state, and can be opened by its true key. In another part of the said Jeremiah Chubb's specification, he described a plan whereby the same key may be made to serve for the true key and for the regulating key, by changing its position in the lock. This he effected by having a small middle plate situated within the lock, having two key holes formed through it at right angles to each other, which operated as follows:—When the lock had been detected by an attempt to violate it or by any other means, the true key was to be introduced into the key-hole, and after being turned one quarter round upon its pin it was to be drawn outwards or away from the main lock plate until its bit passed through the second key-hole, formed in the middle plate before-mentioned. The key was then turned partly round, in which position the steps upon its bit would operate upon the tumblers and regulating bolt in a proper manner, to regulate or restore the lock to its original position: and when this had been effected the key was to be pressed inwards, and returned into its

proper position for opening the lock. All the methods which were described by the said Jeremiah Chubb, for regulating or restoring the state of the lock when it had been detected, were found to be attended with inconveniences, to obviate which has been the entire object of my present improvement, as will be hereinafter fully described. Figs. 1 to 6 (inclusive) upon the sheet of drawing which is hereunto annexed, (Pl. XIII.) represent a lock with its parts, adapted for a door. It is provided with four tumblers, and is furnished with the aforesaid detecting mechanism; but the regulating part is constructed according to my present improvement. Note, the same characters or letters of reference are used to denote corresponding parts upon the figures whenever they occur: 1, the centre pin, upon which the detector moves; 2, the tail or end of the detector, proceeding nearly down to the tumblers B; 3, the hook which detains or holds the main bolt, by falling into the notches 4, cut therein; 5 is the detector spring; it is formed into a triangular piece, at the end which acts against the detector, the end of which is also made in a triangular form. Now if the proper key is introduced into this lock, it will raise the tumblers, B, upon their centre of motion, D, exactly to the required height for the stud, *b*, (upon the main or locking bolt, A), and the stud, 10, (upon the regulating bolt, 7), to pass through their respective openings in the tumblers, as seen in fig. 1 upon the annexed drawing, and thereby the main bolt may be withdrawn or unlocked. But if any false key or other instrument should be introduced into this lock, for the purpose of opening or picking it, by which any one or more of the tumblers, B, should be raised too high, they will also raise the end, 2, of the detector, and depress the end, 3, until the inclined plane or triangular piece of the detector falls under the triangular piece of the spring, 5; then the hook, 3, will be instantly shot into one of the notches, 4, on the main bolt (as shown at fig. 2, where the lock is represented in a locked position), and will retain it so

effectually, that the application even of its proper or true key will have no effect to withdraw the main bolt, nor can the same be moved until the detector has been returned to its original position as aforesaid. I have above described the nature of Jeremiah Chubb's detector lock sufficiently to be enabled to explain clearly to persons conversant with works of a similar description, how my present improvement is to be applied thereto. And I, the said Charles Chubb, do hereby declare, that I make no claim to that detecting mechanism which I have above described, it having only been introduced into this my specification, to show clearly the application of my present improvement; but I confine my claim entirely to the following particulars, that is to say:—I form and apply the regulating bolt in such manner, that the proper or true key which is used to lock and unlock the lock, may also perform the office of relieving the detector to regulate the lock, when it has been detected as aforesaid; and that by simply turning the said key partly round upon its centre pin, in the same direction that it is turned in the act of locking or throwing the main bolt, as shown by the direction of the small dart or arrow in fig. 2. This improvement is effected in the following manner:—The regulating bolt, 7, which is shown in fig. 3, upon the annexed drawing, as laying over the main bolt, A, is adapted to move or slide backwards and forwards along with the main bolt, in the act of locking and unlocking the same, for which purpose it has a groove or opening cut through it, which slides upon the stud, D, in the same manner as the main bolt does. The regulating bolt has also an opening formed through it, for the stud, *b*, of the main bolt to pass through; and this opening is of such length in the direction of the bolt's motion, that the regulating bolt, 7, can slide forwards in a slight degree upon the main bolt, A, even after the main bolt has been fully shot or locked; and it is this extra sliding motion of the regulating bolt upon the main bolt which operates to regulate the lock, or return the detector to its original position,

Fig. 1.

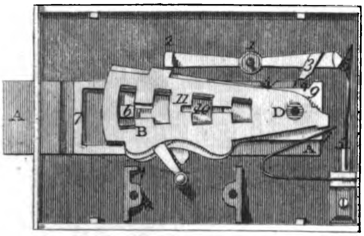


Fig. 2.

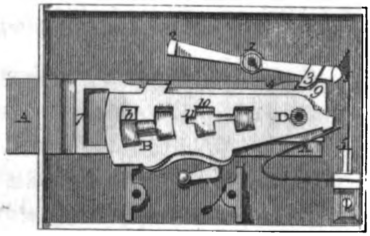


Fig. 3.

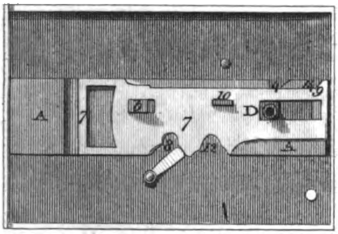


Fig. 4.

Fig. 5.

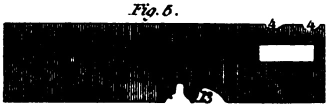


Fig. 6.

Fig. 7.

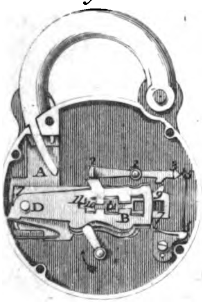


Fig. 8.

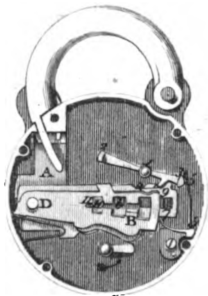


Fig. 9.

Fig. 11.

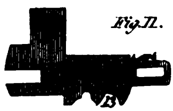


Fig. 10.

Fig. 12.

after the lock has been detected by any means as aforesaid. When the lock is in the act of locking and unlocking, the regulating bolt, 7, is caused by the motion of the key to slide backwards and forwards along with the main bolt, by means of a notch, 8, which is made in its side for the bit of the key to take into, similar to the notch in the main bolt. Now if an attempt is made to violate or open the lock, and by that means the lock should become detected, as shown in the fig. 2, its proper or true key, on being introduced and turned round in the right direction for unlocking or withdrawing the main bolt, will be found not to perform its office, since the main bolt will be retained firmly by the hook, 3, of the detector, and will thus intimate to the proprietor of the lock that an attempt has been made to pick it, in which case he must slide or move the regulating bolt, in order that its inclined plane or wedge, 9, before-mentioned, may force back or relieve the hook, 3, of detector from its hold upon the main bolt. To effect which, he has nothing to do but simply to turn the key in a backward direction, or in the same direction that it is turned in the act of locking or shooting the main bolt, as shown by the small dart or arrow in fig. 2, by which means the various steps upon the bit of the key will first raise the different tumblers, so that their openings, 11, will correspond with each other sufficiently to permit the stud, 10, upon the regulating bolt to enter; then, by continuing to turn the key round a short distance further in the same direction, its bit will enter the second notch, marked 12, in the side of the regulating bolt, 7, and will advance or move the said bolt in a sufficient degree for its inclined plane or wedge, 9, to relieve the detector from its hold; after which the key, on being turned round in the proper direction for withdrawing the bolt, as shown by the arrow in fig. 1, it will open the lock. Note, the main bolt has two notches cut in its side, as shown in the figs. 5 and 6, which represent two views of the main bolt, as detached from the lock. The second notch in the

main bolt, marked 13, is made wider than the notch marked 12 in the regulating bolt, in order that the bit of the key, when moving the regulating bolt forwards, in order to return the detector, might not act upon the main bolt. This improvement, by enabling the true key to be employed in such a simple manner for regulating the said patent detector locks, is found to possess considerable advantage over the modes which were heretofore known and in use, and will, it is presumed, render those locks more generally useful. The said improvement is equally applicable to all descriptions of the patent detector locks before-mentioned, and may, from the description above given, be easily adapted to them, by persons conversant with such works. Figs. 7 to 12 inclusive, upon the annexed drawing, represent a padlock, with its tumblers and appendages, being provided with detecting mechanism, similar to what has been hereinbefore described, and with the regulating part, constructed according to my aforesaid improvement. The same characters or letters of reference which are used upon the various parts of this lock, will be found to correspond with those marked upon similar parts in the figures of the door lock. And since its operation is nearly similar, it will not be necessary to enter into a minute description of it; observing, that the form and proportion of the different parts may be varied according to the discretion of the workmen employed in constructing the same. The materials of which the same may be made may also be varied according to the circumstances of the case, without departing from the object of the invention, as hereinbefore described and set forth.

In witness whereof, &c.

Specification of the Patent granted to Joseph Manton, *of Hanover-square, Middlesex, Gun-maker, for a certain improvement in shot.* Dated March 25, 1825.

TO all to whom these presents shall come, &c. &c. *Now know ye,* that in compliance with the said proviso, I, the said Joseph Manton, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows, (that is to say):—My said invention of a certain improvement in shot, is applicable to the lead shot commonly used in fowling-pieces for killing game, and other purposes, and consists in coating the surface of the shot with the metal called mercury, or quicksilver, whereby it is rendered white, much more convenient for use, more cleanly, and not so liable to injure the quality of the game killed by it, as when prepared in the usual manner, nor to adhere to the barrels of fowling-pieces; and I hereby claim as my invention, any and every mode by which lead shot may be coated with mercury or quicksilver. As, however, it is desirable that I should afford an example of a method or methods of carrying my said invention into effect, I shall proceed to do so as follows: I take the lead shot, in preference before it is glazed with plumbago or black lead, and put it into a vessel, either of a globular or barrel shape, which can be closed, and which I prefer to be made of iron, and capable of receiving either a revolving movement on an axis, or of being agitated backwards or forwards, or in any other fit or proper manner. Into this vessel or vessels, I put about one hundred pounds' weight of lead shot, and about one pound of mercury or quicksilver, and nearly fill it with water. I then briskly stir or agitate the whole together, until I find, on trial, that the whole of the mercury or quicksilver has spread and diffused itself uniformly, and coated the surface of the shot, after which I wash it well in water. I then spread the shot upon a cloth or canvas,

which is stretched on a frame of wood, and rub the shot with a sponge or cloth, which will make it dry quicker. Should the shot lose its silvery colour by being kept a long time, it may be restored by again putting it into a revolving vessel, or one capable of being shaken or agitated, together with some water, and a little mercury or quicksilver, and be treated as before-mentioned.

In witness whereof, &c.

Description of a Quadruple Lock, for securing iron safes and chests. By Mr. J. Duce, Wolverhampton.

From the Transactions of the Society of Arts, &c. Vol. xlii.

The Silver Vulcan Medal, and Ten Guineas, were presented by the Society to Mr. Duce for this invention.

WITH AN ENGRAVING.

This lock, with a single turn of the key, throws out four bolts, one at right angles to each side of the lock; and will, therefore, prevent any door to which it is applied from being opened, even if the hinges have been cut away. If to this be added the great difficulty (probably the impossibility) of picking it, the security offered by it is as great as can be effected or desired.

Locks for safes, which throw out three bolts at once, have been made by various persons, but such locks are only single ones, with the modification of having three bolts instead of one. A lock, therefore, of this description, offers no more difficulties in the way of picking it than are presented by a single-bolt lock of the same construction.

Mr. Duce's lock, however, is a combination of four distinct single-bolt locks, fixed in the same frame and opened by the same key; the bolts, therefore, are shut or withdrawn in succession, and present the two following

advantages. Whatever time and trouble may be required for picking one of the locks must be quadrupled before the whole can be opened; and as the key opens the four locks in succession, the strain on the wards will be much less than in those cases where two or more bolts are moved simultaneously.

Independently of the ingenious manner in which the four locks are combined, there is not much of novelty in the invention. The tumblers are on Chubb's principle, without the detector, and the rest of the lock is on Barron's principle.

Fig. 1, (Pl. XIV.) *o o* the case, *p p* the first bolt, *q q* the second, *r r* the third, and *s s* the fourth bolt; the upper plate is removed, and the lock rests on the inner casing, *t t t t; u u u u* an inner plate, *v v v* three tumblers lying on it for the three first bolts; beneath each of these tumblers, and under the plate *u u*, are two more tumblers, making three for each of these bolts; the last bolt, *s s*, has but one tumbler, *w*, placed under the plate *u u*, which is moved by the corners of an intermediate piece, *x x*, which turns on the pin, *y*, as is shown by dotted lines. The key, *z*, is represented as having thrown out the first bolt, *p*, and beginning to protrude the second, *q*; it then acts on the bolt *r*, and lastly on the bolt *s*, moving them to places shown by dotted lines. It withdraws the three first bolts in a reverse order, but finishes with the last, *ss*, in either case.

Fig. 2. The key.

Description of a new Remontoire Escapement, by which the motive force is transmitted to the escapement uniformly, and without impeding the vibration of the Pendulum. By Mr. J. Aitkin, *of St. John-street, Clerkenwell.*

From the Transactions of the Society of Arts, &c. Vol. xlii.

The sum of Twenty Guineas was given by the Society to Mr. Aitkin for this invention.

WITH AN ENGRAVING.

Fig. 3, (Pl. XIV.) is a view of the escapement, having the front plate removed.

Fig. 4 is a side view.

Fig. 5 is a longitudinal view of the axis of the escapement-wheel, and a section of its appendages.

(The same letters refer to the same part in each figure.)

A A Is the front plate, and B B the back plate, the lower part of which is represented as broken off: the dotted circle, D, represents the fuzee-wheel, which works into the pinion *e*.

E Is the second wheel, which is fixed on the axis of the pinion *e*, and works into the pinion *f*.

F The third wheel, which is fixed on the axis of the pinion *f*, and works into the pinions *g* and *h*.

G The escape wheel; H the palettes.

The pinion *h* is fixed on the axis *i i*, and also eight spring detents, *j*, *k*, *l*, *m*, *n*, *o*, *p*, *q*, the ends of which rest against the cylindrical side of the axis, *r r*, of the escape-wheel, and escape through the notches 1, 2, 3, 4, 5, 6, 7, and 8, in succession, as the axis *r r* turns round.

The position of the gaps, in the side of the axis *r r*, is represented in fig. 6 by the figures 1, 2, 3, 4, 5, 6, 7, and 8.

The axis or arbor, *r r*, on which the escape-wheel is fixed, passes through a cylindrical hole in the pinion *g*, and is at liberty to turn freely within it.

s Is a collet, which is fixed on the socket of the pinion *g*.

Fig. 7 is an end view of the collet *s*, together with the

helical spring, *t*, one end of that spring being fixed to the collet *s*, and the other end to the collet *u*.

Fig. 8 is an end view of the collet *u*: this collet is fixed upon the arbor *r r*, by the set screw *v*, and by means of it the spring *t* may be wound up to a proper strength, so as to overcome the friction of the axis *r r*, and cause the escape-wheel, G, to turn round. When the clock has been wound up, the pendulum put in motion, and the axis, *r r*, of the escape-wheel has turned one-eighth round, the detent, *j*, will be at liberty to pass through the gap, g: then the wheel, F, will cause the pinion, *h*, together with the detents, to turn one-eighth round; consequently, the detent, *k*, will be turned till it rests against the cylindrical side of the axis, *r r*, opposite to the gap, 7; the wheel, F, will also at the same time turn the pinion, *g*, together with the collet, *s*, one-eighth round, which will rewind the helical spring, *t*, and give sufficient power to the escape-wheel, *g*, to make one-eighth of a revolution more by the unwinding of the spring; the detent, *k*, will then be at liberty to escape, and the wheel, F, will again cause the pinions, *h* and *g*, to turn one-eighth round, and at the same time the helical spring will be again wound up.

In this instrument the swing-wheel acts with an equal force, when the motive power is even doubled, without affecting the isochronism of the pendulum. This is not the case in the clocks hitherto constructed by Mudge, by Cumming, and others of a later date; for all those, more or less, are affected by the irregularity of the train, and therefore the pendulum is more or less disturbed by the unlocking of the detents.

Those who possess clocks on the remontoire principle, as hitherto constructed, will find, on trial, that by adding a double weight, the irregularity will increase, or rather the clock will stop altogether. But an increase of weight will not stop my time-keeper, nor cause any irregularity

in its motion. They will also have the mortification to find, on trial, that the usual dead beat escapement is absolutely preferable to those elaborate escapements.

An objection may arise respecting my contrivance, namely, that the renovating spring, in its unbending, is weaker than when bent up; but these inequalities are constantly the same every 6″, and therefore do not destroy the isochronism of the pendulum. It would, perhaps, be better to have ten notches in the cylinder, in which case the spring would be unbent once in 6″. The notched cylinder may be about the tenth of an inch in diameter.

Proposal for constructing a Grooved Stone Tunnel under the Thames, to be put down by means of strong coffers. By ALBEDO.

Abstracted from the Papers and Documents of the "THAMES ARCHWAY COMPANY."

WITH AN ENGRAVING.

HAVING considered the various ways by which tunnels may be constructed under rivers, and weighing the difficulties against each other, I am of opinion that a tunnel made through the river would be preferable, and less expensive, than an under-ground one, where it can be formed without any material impediment to the navigation; because dangers and difficulties which will, from quicksands and unforeseen things, arise, and which require the utmost precautions of the engineer to guard against, would be easily overcome, and the depth of the strata between the top of the tunnel and the bed of the river would be considerably less than required for an under-ground plan; consequently, the ascent of the tunnel must be less, and the line shorter.

The plans herewith submitted to the inspection of the Thames Archway Company, are for the construction of a tunnel in the bed, and through the river, of sufficient

Fig. 4.

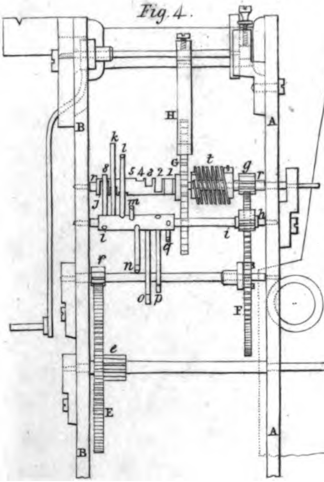


Fig. 3.

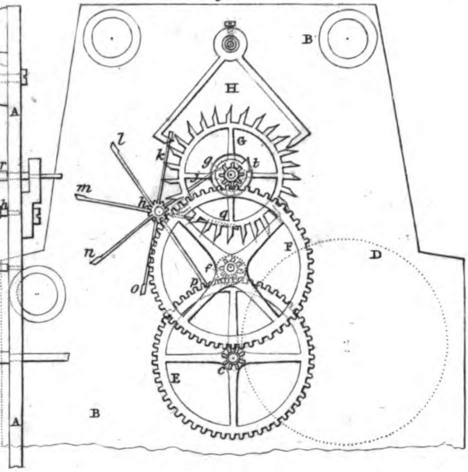


Fig. 6.

Fig. 5.

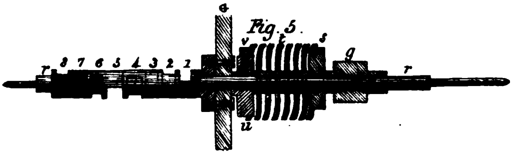


Fig. 8.

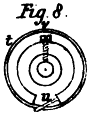


Fig. 7.

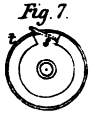


Fig. 9.

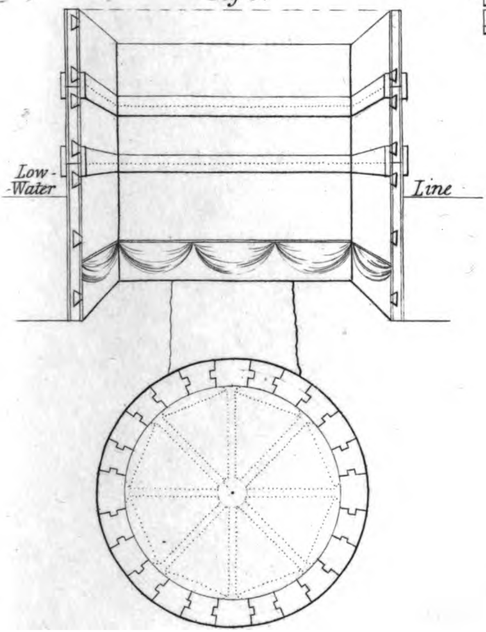
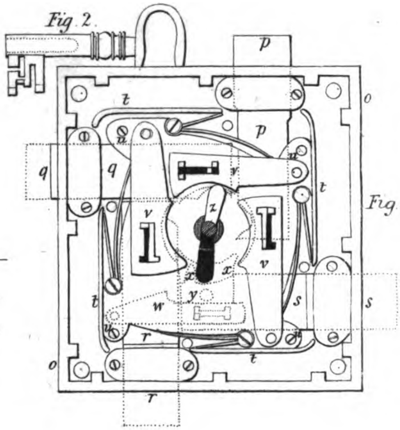


Fig. 2.



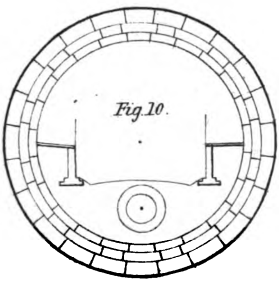


Fig. 10.

extent to admit of two carriages to pass each other, with a terrace or footway on each side, wide enough for three persons to walk abreast, which no doubt can be executed with certainty in any line within the given space, I conceive no advantage will be gained by removing it. I shall therefore propose the line already laid down, and for which the driftway can be converted into a drain, and the work carried into effect with very little, if any, impediment to the navigation of the river. The interior of the tunnel is a matter of fancy. A footpath on one side, of double the width, or one in the centre, and the carriages to pass on each side, raised about 10 inches above the carriage-way, may answer every purpose, and save considerable expence. But the terrace will be far preferable, as the footways will gain about 6 inches each in width, without diminishing the carriage-way, and be a much greater security for passengers. The top of the tunnel on this plan will be on the average about 5 feet under the bed of the river, in some places more, in others not so much; and the work will occupy a space of about 40 feet in the river, which will be little or no obstruction to the navigation.

I propose lighting the tunnel with gas, on Mr. Windsor's principle. The expence of completing the said works, agreeable to the plans, is estimated at one hundred and twenty-two thousand pounds. The tunnel may be enlarged or diminished if thought proper, which will of course enlarge or diminish the expence.

The proposed tunnel is to be built of key stones, 4 feet thick, in a gun-barrel form, 27 feet wide in the clear; the drain to run from the centre of the tunnel to the shaft already sunk on the South shore, to be worked in the driftway already got through. The length of the carriage way is 1183 feet in the tunnel; from the end of the tunnel to the surface on the South side, 122 feet; and on the North side, 93 feet, making the whole line of carriage way 1398 feet.

Fig. 9 (Pl. XIV.) is a transverse section of the tunnel and frames or coffers, as more particularly described in the specification hereinafter-mentioned, with the tunnel planked and dammed up, ready for the carrying forward the frames; and also shows the method of grooving the stones into each other lengthways.

Fig. 10 is a transverse section of the tunnel, showing a section of the interior road and foot-ways and drain, and the transverse grooving the stones together.

A SPECIFICATION *of the several works and apparatus necessary for a Tunnel under the river Thames, agreeable to the Plans herewith exhibited.*

1st, A steam-engine of 18 or 20-horse power, capable of keeping two pumps constantly at work, and of drawing up the soil as it shall be excavated from the bottom of the river, is to be erected in a lighter.

Then strong frames or coffers, 40 feet square, made of oak, or sound Riga or Memel timber, 10 inches square at the least, strongly framed and bound together with iron bolts and straps. The timber to be properly squared, so as to form a close joint. The first or bottom frame must be 20 feet high; the other two frames 10 feet high each, to admit of being moved with greater ease; to be boarded inside and out with sound two inch plank; the seams or joints to be caulked and made water tight, the same as the sides of a ship, and then pitched. They must also be made with grooves or rabbets, so as to fit one on the other properly close, which grooves or rabbets must also, when the frames are fixed, be caulked and made water tight, and pitched. It would be best to put these frames together on barges, for the purpose of being easily launched.

The engine and frames being complete, the workmen may proceed to work, first opening the ground in Mr. Burr's yard, on the South shore, digging to the depth of the bottom of the tunnel at that place, which will be about

48 feet, taking care to plank and shore up the sides as they go down; the opening to be about 16 feet, to be enlarged as the stones are laid in.

The tunnel being this way worked, until it comes near the water's edge, the bank of the river is then to be notched in, to admit of the first frame, of 20 feet high, so far in as to be about 5 feet over the work already done. This is to be fixed at low water, and the bottom on the inside to be dammed up and made water tight with clay, or other materials best for that purpose. The engine in the lighter is then to be brought up with the tide, and moored alongside the frames, to draw off the water, should there be any leakage or springs to incommode the workmen, and to draw up the soil as it is excavated.

It may be found necessary to have something to fix the frames to prevent the tide shifting or moving them; in which case a few piles must be driven into the ground, at proper places, to which they are to be made secure.

The ground being excavated, and the tunnel got in, it must be covered over 2 feet thick with clay, properly tempered and rammed hard, over which chalk and gravel must be laid, and rammed as hard as possible, until up to the original level. This must be continued on the top of the tunnel all through the river. This being done, the piles are to be drawn and the frames brought forward, leaving about 5 feet over the end of the work. The piles are then to be driven, the bottom secured, and the work to proceed as before.

The work will go on in this way for 3 or 4 frames, until the river becomes deeper, and the work got forward to low-water line, after which it will be impossible to fix the frames dry. Then the first frame must be sunk at low water, and the other frame or frames (as the height of water may require) must be fixed on and caulked as before directed. And as in all probability the frames will not stand level on the bed of the river, which no doubt is higher in some places than in others, consequently the

water will come in faster than the engine can draw it out. To obviate this difficulty a curtain, of sufficient length to lie 3 or 4 feet on the ground, made of sail cloth, properly tarred, the bottom to be loaded with iron or lead weights, must be fixed to the inside of the first frame, as shown in fig. 9 in the plans, which must be drawn up with cords while sinking.

When the first frame is fixed in its proper place, the curtain must be dropped, after which a quantity of clay, in bags or otherwise, as may be found best, is to be thrown in all round the inside of the frames, until the bottom is secure. The engine will then draw out the water, and the workmen, after further securing the bottom, may proceed as before. When the work is got down to the bottom of the descent, it will be proper to make the drain as hereinafter directed, which is to be continued with the work to the centre of the tunnel; and afterwards, in a temporary way, along with the work. This will draw off the water, and assist the floating engine.

These operations are to be repeated until the work is got forward to the holes. And if the quicksands should run deeper than the bottom of the work, piles must be driven, and gravel and chalk stones well rammed in, until a solid foundation is obtained, which, if necessary, must be planked. Should the sands come in sideways, wooden dams must be formed and sunk in the earth on the outside of the work. By these means, and proper precautions, the tunnel will be formed through the river to the North shore, at which place the workmen will act in the same manner as before directed, in Mr. Burr's yard, on the South shore.

The end of the tunnel, as shown at fig. 9 in the plans, must be planked and dammed up at every length before the frames are moved, to prevent its being choked up. The tunnel, being worked through the river, is to be finished in the same manner at both ends.

The mason must take great care in selecting the hardest

and best stone for this purpose, to be properly guaged, jointed, and grooved into each other, as shown by plans, figs. 9 and 10, and to be set in cement impervious to water. The stones must be properly worked and fitted to each other before they are brought to the work, that they may go together directly without any trouble.

A brick gun-barrel drain, 3 feet wide, and 9 inches thick, inside the tunnel, is to be carried in the same direction as the tunnel from the centre to the rise, where it must go through, and from hence be made 18 inches thick to the driftway, which must be sunk lower towards the shaft, to give it a proper current.

INTERIOR OF THE TUNNEL.

The stones and drain are to be covered first with clay, then with loam, and on the top with gravel, until it is 9 feet high to the level of the carriage-way ; these are all to be rammed and rolled down as hard as possible.

The bricklayer is to build a 9-inch wall, with proper footings, 3 feet 8 inches high from the level of the carriage-way, and 5 feet 4 inches high from the arch, sideways, to the outside of the wall at top. The wall to be built of sound hard-burnt grey stocks, laid with a neat flat joint, jointed and well flushed up. The space between the arch and this wall is to be filled in level to the top with earth.

The pavier is to lay the terrace or footway with York paving, two inches higher on the inside than on the out, to give it a current. The stones are to be of a uniform size, and not less than two inches thick, and to project two inches over the wall.

The smith is to make and fix a fancy cast-iron railing on the terrace, 3 feet 6 inches high, and fancy lamp-irons on ditto, and to make what wrought iron may be necessary for the railing, lamp irons, &c. and to make two strong wrought-iron grates for the drain.

Report of the Select Committee of the House of Commons, appointed to inquire into the state of the law and its consequences respecting the Exportation of Tools and Machinery. (Concluded from p. 345.)

Supposing, indeed, that the same machinery which is used in England could be obtained on the Continent, it is the opinion of some of the most intelligent of the witnesses that the want of arrangement in foreign manufactories, of division of labour in their work, of skill and perseverance in their workmen, and of enterprize in the masters, together with the comparatively low estimation in which the master manufacturers are held on the Continent, and with the comparative want of capital, and of many other advantageous circumstances detailed in the evidence, would prevent foreigners from interfering in any great degree by competition with our principal manufacturers; on which subject the Committee submit the following evidence as worthy the attention of the House, (viz. Mr. Galloway's):

"I would ask whether, upon the whole, you consider "any danger likely to arise to our manufactures from com"petition, even if the French were supplied with ma"chinery equally good and cheap as our own?—They will "always be behind us until their general habits approxi"mate to ours; and they must be behind us for many "reasons that I have before given.

"Why must they be behind us?—One other reason is, "that a cotton manufacturer who left Manchester seven "years ago, would be driven out of the market by the "men who are now living in it, provided his knowledge "had not kept pace with those who have been during that "time constantly profiting by the progressive improve"ments that have taken place in that period; this pro"gressive knowledge and experience is our great power "and advantage."

It should also be observed, that the constant, nay almost daily, improvements which take place in our machinery itself, as well as in the mode of its application, require

that all those means and advantages alluded to above, should be in constant operation; and that, in the opinion of several of the witnesses, although Europe were possessed of every tool now used in the United Kingdom, along with the assistance of English artisans, which she may have in any number, yet from the natural and acquired advantages possessed by this country, the manufacturers of the United Kingdom would for ages continue to retain the superiority they now enjoy. It is indeed the opinion of many, that if the exportation of machinery were permitted, the exportation would often consist of those tools and machines which, although already superseded by new inventions, still continue to be employed from want of opportunity to get rid of them, to the detriment, in many instances, of the trade and manufactures of the country; and it is matter worthy of consideration, and fully borne out by the evidence, that by such increased foreign demand for machinery the ingenuity and skill of our workmen would have greater scope, and that, important as the improvements in machinery have lately been, they might, under such circumstances, be fairly expected to increase to a degree beyond all precedent.

The uniform policy of the legislature of this country has been to give, as they conceived it, every kind of encouragement to British manufactures, by prohibiting the importation of foreign manufactures, and by giving premiums, bounties, and drawbacks on the exportation of British manufactures; but the great and important manufacture of machinery, tools, and utensils, has been made an exception to this system of legislation by restricting its exportation, although it is a manufacture peculiarly adapted to the circumstances of this country, and one that affords as many advantages in the way of giving employment to the people, and yielding profit to the master manufacturers, as any other manufacture.

The many important facilities for the construction of machines, and the manufacturing of commodities which

we possess, are enjoyed by no other country, nor is it likely that any country can enjoy them to an equal extent for an indefinite period. It is admitted by every one that our skill is unrivalled; the industry and power of our people unequalled; their ingenuity, as displayed in the continual improvement of machinery and production of commodities, without parallel, and apparently without limit. The freedom which, under our Government, every man has to use his capital, his labour, and his talents, in the manner most conducive to his interests, are inestimable advantages; canals are cut, and railroads constructed, by the voluntary association of persons whose local knowledge enables them to place them in the most desirable situations; and these great advantages cannot exist under less free governments. These circumstances, when taken together, give such a decided superiority to our people, that no injurious rivalry either in the construction of machinery, or the manufacture of commodities, can reasonably be anticipated.

Your Committee, before they conclude, think it proper to remark, that by the act of last Session permitting artizans to emigrate and reside abroad, the country, as regards machine-making, is placed in a different situation from that in which it formerly was; and, from the evidence taken before the Committee, both in the last and present Session, in regard to the ease with which all plans, models, and drawings of new inventions in machinery are conveyed to the Continent, and the facility with which some engineers assert that good workmen can construct machinery from them, it is probable that if the present prohibitory policy is persisted in, foreign nations will be obliged to establish manufactories, (as has been already partly done in France, the United States, &c.) for those articles with which we refuse to furnish them, and which a liberal course of policy would entirely prevent.

The Committee deem it proper to submit an extract on this subject from the evidence of Mr. Henry Maudslay, an

eminent engineer, as deserving the particular attention of the House:

"Can you state whether the manufactories for machinery "are increasing on the Continent?—Very greatly; I have "seen a number of them.

"Of what manufacture?—Of the manufactory of steam "engines and other machinery.

"What would be the effect of exporting machinery "upon the extension or diminution of the manufactories "on the Continent?—They would diminish them there is "no doubt; they would never set to work to furnish the "French manufacturers with French-English machinery if "they could get them from England.

"Do you consider the superiority of the English ma-"chinery such as to secure a demand in the foreign "markets, if the laws permitted you to supply them?—"There is no doubt about it.

"Is it within your knowledge that the French are in "possession of drawings and plans of almost every patent "as soon as they are published in England?—Yes, I know "from circumstances that have come to my own know-"ledge. On the first of every month, books are packed "off to Hamburgh, and sent through Holland and all parts "of the Continent, and a friend of mine has written to me "within a week of the publication, saying I understand "you have obtained a patent for so and so, and I hope it "will turn out to your advantage, and so on. This is a copy "of the French Repertory of Arts [*alluding to a book* "*produced by the witness*], and this is a drawing of a ma-"chine, and is as good a plan as a man need to work from, "and I know this machine was not at work in our mint "when this book was published in France; I believe they "(Messrs. Bolton and Watt) had one in their manufactory; "but this shows the facility of getting these things in "France.

"Can a machine-maker work from that drawing?—Per-"fectly well.

"You mean to say that any man that is able to make "that machine can make it from that drawing?—Yes.

"Have you any other example of the same thing?—Here "is a blowing machine, to smelt ore, and that is as good "a blowing machine as any man need make; some of "our first mills have that machine.

"Whose invention is that originally?—It is the inven-"tion of Bolton and Watt, or some of the large iron-"masters.

"Does your observation as to the facility of working "from drawings apply to all sorts of machinery?—Yes; "there is a set of drawings in the best Encyclopedias "which will enable you to make a cotton machine.

"Is the drawing of that loco-motive machine [*alluding "to an engraving in the book produced*] such as will enable "a workman to make a similar machine?—Certainly; "they make a great many thousand machines from much "worse drawings, no doubt."

Although your Committee are impressed with the opinion that tools and machinery should be regulated on the same principles as other articles of manufacture, yet inasmuch as there exist objections in the mind of many of our manufacturers on this subject, which deserve the attention of the legislature; and as it is possible that circumstances may exist which may render a prohibition to export certain tools and machines used in some particular manufacture expedient, your Committee beg to recommend that, until an alteration can be made in the laws on this subject, His Majesty's Privy Council should continue to exercise their discretion in permitting the exportation of all such tools and machines now prohibited, as may appear to them not likely to be prejudicial to the trade or manufactures of the United Kingdom.

30*th June*, 1825.

On the Causes of the Hardening of Lime of various kinds.

By M. Hassenfratz.

Continued from page 388.

If we cannot attribute to the combination with the carbonic acid, solely, the hardening of the limes and mortars exposed to the action of the air, what can or ought to be the cause which, with the carbonic acid, contributes to their induration?

The pure carbonates of lime lose, on an average, 0·45 of their weight in calcination, and 0·10 of their bulk, when they are made into lime. These 0·45 consist of water and of carbonic acid; but it is difficult to determine the proportion of those two substances. Bergman, who only found 0·44 in his analysis, values the carbonic acid at 0·33, and the water at 0·11. But was his carbonic acid completely freed from water? We estimate the carbonic acid at 0·34, and the water at 0·10, in his analysis of 0·44. Wherefore, in order to regenerate, completely, one part of lime into carbonate of lime, it must be combined with 0·61 of carbonic acid, and with 0.18 of water.

For a long period the analysis of carbonate of lime made by Bergman was alone known; but since the end of the last century, a great many analyses of it have been made, with very great care. In these analyses all the chemists agree in having found in the carbonate of lime but an extremely small proportion of water. M. Thenard, in his comparative analysis of Iceland spar, which he considers as a very pure carbonate of lime, and in that of aragonite, found them to be composed of

Lime	0·563
Carbonic acid	0·433
Water	0·004

Thus, these calcareous crystals contain only 0·004 of water of crystallization, a quantity which appears very

small. In the analysis of the coarse carbonates of lime which are used in building, and for making lime, there is found from 0·01 to 0·02 of water, and sometimes more when these stones are moist.

We have seen in slacking rich lime by the three different methods, that it is moistened in the first with four parts of water by weight; in the second, by immersion, that it requires at least 0·20 of water to become solid; and by the third, or spontaneous slacking, that its weight is increased 0·46. M. Vicat only found, in the first method of slacking, 3·6 of water combined with it; in the second but 0·18; and in the third only 0·40. We adopt here the results of M. Vicat's experiments.

Having reduced a kilogram of quick lime to a paste somewhat firm, after having slacked it by the three different methods, M. Vicat observed that the lime slacked by the first method became combined with 2·36 of water, and that its bulk was 3·1 of that of solid lime; by the second method the combined water was 1·31, and the bulk 1·04; and by the third method the combined water was 1·48, and the bulk 1·76. As the calcareous stone, which is fit to make very rich lime, loses 0·1 by calcination, it follows that, in order to be restored to the bulk which it had before calcination, it ought only to be increased 0·11 of the bulk which it has in the state of lime. Thus, to be brought back to the original bulk of the calcareous stone, it is requisite that the lime slacked by wetting should lose 0·64 of its bulk; that the lime slacked by immersion should increase 0·06; and that the lime slacked spontaneously should lose 0·37. The two portions of lime slacked by wetting and spontaneously, must then, as has been seen, be considerably diminished in bulk, while, on the contrary, the lime slacked by immersion ought to be increased.

It follows, moreover, from those experiments, that since there are limes whose bulk, after being made into paste, is less than that of the stone which has produced

them, it is most probable that in becoming solid, and being regenerated, they would be increased in bulk.

Let us consider for a moment by itself, the lime mixed into a paste with water, what a contraction must take place in it to bring it back to its original volume; and how many chances of separation and cracks must it experience in drying and becoming solid? If the lime becomes regenerated, all the water must be evaporated, and be replaced by carbonic acid. As the proportion of carbonic acid ought to be 0·82 of the lime, it follows that 2·36 of water in the first method of slacking it, 1·31 in the second, and 1·40 in the third, ought to be replaced by 0·82 of carbonic acid. Besides, that the loss of the weight of the lime slacked by mixing it with water ought to be 1·54; for the lime slacked by immersion, 0·49; and for that slacked spontaneously, 0·58.

And if the exterior surface of the masses of lime should soon become hard in combining with the carbonic acid which it receives from the air, its volume could not be perceptibly diminished any farther; after which it is evident, that either the lime will remain in a paste in the interior of the mass, in preserving all the water which it absorbed, or that this water will evaporate through the regenerated coat. In the first case, the lime will always remain in its caustic and slacked state; and in the second, the inside will be filled with cracks and with vacuities, which will render the mass pulverulent, and will prevent it from acquiring solidity. If we suppose that the carbonic acid percolates into the mass, and regenerates the lime which it finds there, all the water will be evaporated, but the carbonic acid will only fill a part of the space; the mass will be porous, and full of vacuities. Finally, to prevent vacuities, it is necessary that only the quantity of water should be evaporated which would be replaced by the carbonic acid, and that the other part of it should remain; but in this case the volume of the water would be too considerable, and its layers, or films, too thick to

perform the office of water of cohesion, and the mass would still have but little tenacity; from whence it will appear, that the best method of employing the lime, and that which will most favour its solidification, is to slack it into a dry powder, either by immersion or by spontaneous action. In fine, only to add to it the quantity of water necessary to make its volume 1·11 of that which the lime held before it was slacked; then the lime will become regenerated in acquiring the solidity and hardness which the stone possessed.

Few substances, perhaps, have as much affinity for water as lime; when it is pure, when it is entirely deprived of it, it seizes on it with great force; the lime becomes solid in uniting with it. To unite with its particles the water penetrates the mass, breaks the cohesion of the atoms of the lime to insinuate itself between them, and causes the lime to become pulverulent. This fact proves that the affinity of water for lime is greater than that of the particles of lime for one another, and that the force of the cohesion of the water to the lime is more considerable than that of the atoms of the lime to each other.

It is easy to conceive from this fact, that if the particles of lime were united by the water of crystallization, their force of cohesion would be greater than that of the particles to each other. All then that is necessary to obtain a very hard hydrate of lime, is to reunite the particles of lime to each other by very thin films of water, which may be effected by a slow and continued desiccation of the lime in a state of paste; but pure lime, when it has become a solid hydrate, has still a great affinity for water. If in this state it is exposed to the action of the air, it attracts the humidity which it contains; a division of this liquid between the air and the hydrate of lime then takes place, until the affinities of those two substances for water become in equilibrio. The hydrate of lime thus remains in a state of hardness, depending on the thickness of the films of water interposed between its particles.

This thickness diminishes in a dry air, and increases in a moist air, which causes the hardness of the hydrate to vary. To keep it in a constant state of hardness, it is necessary that the action of the lime on the water be diminished by that of some other substance combined with it, which effect carbonic acid produces in uniting to the lime; but every thing leads us to believe, if the analyses of the carbonates of lime are exact, that the carbonic acid drives off all the water of combination, and occupies its place.

We may then impute the hardening of the lime to two causes. 1st, To the action of water on the lime, which occasions a force of cohesion by so much more powerful as its quantity is smaller; or, more properly, as the thickness of the films of this liquid between the particles of the lime is less considerable. 2dly, To the combination of the carbonic acid first with the hydrate of lime, and then with the lime itself; a combination which not only diminishes the affinity of the lime for a new quantity of water, but which entirely displaces the water.

Every thing leads us to believe, that the substances which diminish the affinity of the water for the lime, such as magnesia, clay, the silicate of magnesia, &c. produce an effect analogous to that which water exercises on it; to which effect may be attributed the promptitude with which argillaceous limes set, such as the Roman cement of England, the plaster cement of Boulogne, and many other meagre limes; but every thing leads us to believe, that these same substances equally diminish the action of the carbonic acid on the lime.

The analyses of ancient mortars made by M. John, and which he has published in his *Memoir on Mortars*, which was crowned by the academy of Berlin, confirm our opinion, by proving that limes, in mortars exposed to the air, however ancient they are, do not always reabsorb the quantity of carbonic acid necessary to saturate them, and that they all contain water in smaller or greater quantities,

which quantities are, with some few exceptions, in an inverse ratio of those of the carbonic acid absorbed, and in the direct ratio of those of the other combined earths.

We shall here give some of the analyses made of mortars exposed to the air.

SPECIES OF MORTARS.	Lime in the state of carbonates.	Lime combined with other substances.	Carbonic acid.	Combined silex.	Alumen and iron oxide.	Water.	Sand or cement, mixed with one part of lime.
Mortar of 100 years old, from the church of St. Peter at Berlin, at the outside joints	0·400	0·085	0·300	0·050		0·165	4·000
Mortar of 100 years old, from the inside joints of the same church	0·393	0·207	0·288	0·060		0·042	4·000
Mortar of 600 years, from a covered foundation of the same church, very hard and very tenacious	0·121	0·309	0·081	0·174		0·315	3·180
Mortar of 600 years, from the walls of the Cathedral at Brandenburgh	0·408	0·127	0·307	0·077		0·080	2·910
Roman mortar, from a wall of the city, built at Cologne, under Agrippa, in the 1st age of the Christian Æra	0·383	0·103	0·283	0·008	0·008	0·129	2·249
Roman mortar, from a tower constructed by Agrippa	0·361	0·180	0·272	0·015	0·067	0·105	1·273

It may be seen in these analyses, that one of the mortars which had lasted for six hundred years, and which was very hard and very tenacious, held 0·315 of water; that it had only absorbed 0·081 of carbonic acid; that out of 0·430 of pure lime, only 0·121 had been reconverted into carbonate, and that 0·309 had remained in the state of hydrate of lime. We may then attribute the extreme hardness of this mortar to the water combined with the lime, and interposed between its particles, consequently to the water of cohesion. We may likewise perceive that some of these mortars had absorbed a considerable quantity of carbonic acid, since it amounted in them to 0·307, and that others had absorbed the very small quantity of 0·081. Finally, that the mortar which had absorbed the least of the carbonic acid, or 0·181, contained the largest quantity of foreign matter, or 0·174, while that which had absorbed 0·300 of carbonic acid contained the least foreign matter, or 0·050, that is to say, about $\frac{1}{7}$ of the first lime.

Perhaps the more speedy setting of rich limes, which have slacked spontaneously, or of those which contain foreign substances, may in many cases be attributed to the same causes which determine the setting of mortars, and that we may consider limes of this kind as mortars formed naturally. In fact, lime slacked spontaneously, and which has been exposed a year or more to the action of the air, is a hydrate of lime mixed with a quantity, more or less great, of regenerated calcareous stone. It is then a mortar, in some degree analogous to that which is formed of slacked lime, and of chalk, stone dust, or marble powder. These limes ought to become hard more easily as the proportion of the lime to the carbonate of lime is most suitable. A question will arise with regard to mortars of this sort, whether the lime will not have sufficient action on the carbonate of lime to deprive it of a portion of its carbonic acid, and thus favour its induration and regeneration? We will leave this question to the determination of those engineers who are occupied with limes, mortars, and cements.

Of the setting or hardening of Lime in Water.

We have seen that pure limes had a strong affinity for water; that they solidified it and formed in this manner dry hydrates of lime; and that afterwards the water had a great affinity for those hydrates of lime, dissolved them, and made them pass to the liquid state.

Every lime whose hydrate will be in a state to be attacked by water, and be dissolved by it, cannot be employed in water, since this liquid will dissolve it in saturating itself with it. If the quantity of water in which the hydrate of lime is plunged be limited, the solution is continued until all the water is saturated; during this time the surface of the water exposed to the action of the air will attract carbonic acid; the dissolved lime will seize on it in abandoning its water of solution; a layer of the carbonate

of lime will form on the surface, and afterwards fall to the bottom; the freed water will dissolve more lime, and the solution will thus continue until all the lime is dissolved and converted into the carbonate of lime. If the volume of water is infinite, as that of the sea, or if it is incessantly renewed, as in a current of water, a stream, or a river, the hydrate of lime will be continually attacked by the water in contact with it, and will be dissolved until the entire mass disappears.

Thus, the first thing necessary in employing limes in water, is to render their hydrates less soluble in water; or otherwise to give the limes a property by which they will have sufficient action on the water to form hydrates, and the water shall not have action enough on the hydrates to dissolve them.

This result will be obtained by combining pure lime with magnesia, with clays, with the silicates of magnesia, and finally with the earthy and metallic mixtures, which diminish or destroy the dissolving action of the water on the lime.

It is necessary to obtain this result, that the substances which are mixed and burned or baked with the lime should have an affinity with this earth, and that they should be themselves insoluble in water, such as magnesia, clay, more or less earthy, silex, the silicates of magnesia, &c. Every thing leads to the belief, that alumen (or clay), although insoluble in water, will not make the hydrate of lime equally insoluble, because that probably it does not combine with it intimately. Thus silex, when it is combined with lime, contributes to render its hydrates insoluble, whilst, when it is only mixed with it, none of its natural properties are changed.

The more the *alyudors* (that is to say, the substances which have the property of rendering the hydrates of lime insoluble in water) are combined in large proportions with pure lime, the more its hydrates are insoluble; and as the proportion of *alyudor* is smaller, their insolubility

is less; nevertheless, in order to obtain a good lime, certain limits must not be passed, which are those where the proportion is such that it has no more action on water, or can be no longer slacked and form hydrates.

We have seen that the over calcination of rich limes give to their hydrates the property of being no longer soluble in water, as if they had been combined with magnesia or clay, &c.; does this arise from a portion of the lime having lost the property of uniting and combining with water, or from its having lost by the over calcination a part of its action on the water? Or finally, because in the common calcination there still remains a little water combined with the lime, which favours the union with more water, and that in the over calcination either all the water is carried off, or that part of it which was necessary to its slacking, and the formation of the hydrate? We will here only remark that this result is analogous to that of the union of water with clay. While the desiccation of the clay is not carried far enough, this silicate can receive new water, and be kneaded; but when the desiccation is carried too far by the action of the fire, then it can no longer unite intimately enough with water to be tempered, and acquire the pastey state. It remains hard, and in order to restore its first properties relative to water, it must undergo certain operations. The same takes place with pure limes combined with magnesia, clay, &c.; they have need, to acquire all the action which is necessary for them, to undergo a calcination capable of driving off the carbonic acid and the water which they contain, that they may combine intimately with the earths; but, relative to the nature and the proportions of the component parts, they ought to undergo a particular degree of calcination; since, if too much calcined, they will become without effect, like dead lime; it is then said that they are vitrified. When nearly approaching to this degree of calcination they cannot be slacked in water, nor do they slack

in the air; but being pulverized, they soften like gypsum and set pretty quickly.

Now that we know that one of the chief qualities of lime destined to set in water should be to have no more affinity to water left in it than what is necessary to form hydrates, it is easy to explain their hardening in water by the film of water interposed between their particles; that film of water whose two surfaces ought to have an equal effect on the adjoining particles of lime; that film of water which may be diminished, because the particles of lime come sufficiently near for their mutual affinity to commence its action; then the force of cohesion is composed first of that of the particles for the film of water, and next of that of the particles of lime for each other; a force of cohesion which increases continually in proportion as the particles approach each other.

From these principles it is easy to conclude, that the pastey and firm masses of lime, whose hydrates are not dissolved by water, being placed beneath water, experience continually a pressure of that fluid on all its surfaces; that this continual pressure tends to bring the particles of the hydrates close to one another, to cause the superfluous water to pass off, to diminish the thickness of the films of water, and to increase continually the force of cohesion, from whence the hardness of the lime arises.

If this water contains carbonic acid gas in solution, this gas may approach the surface of the mass of lime, and regenerate calcareous stone, which will place these limes in a situation analogous to that which takes place in the air; but being placed in a situation more favourable, they will be, besides exposed to a pressure, constantly exerted, which will tend to draw together the particles of lime, and to diminish the thickness of the films of water which separate them.

We have, besides, in the three analyses which M. John made of hydraulic mortars, that is to say, of mortars or

cements plunged in water; proofs of this double action of the films of water, and of the carbonic acid in the hardening of these sorts of mortars.

KINDS OF MORTAR.	Lime in the state of carbonate.	Lime combined with other substances.	Carbonic acid.	Combined silex.	Alumen and oxide of iron.	Water.	Sand or cement, mixed with a part of the lime.
Mortar, 300 years old, from the inclosure of the Castle of Berlin	0·032	0·136	0·022	0 088		0·722	3 445
Ancient Roman hydraulic mortar	0·281	0·37 6	9·214	0·0[illegible]3		0·127	8·514
Mortar of Treves, 4 years old	0·044	0·447	3·033	0·119		0·347	

Among these mortars there is one which had only 0·32 of lime regenerated, and which retained 0·722 of water. Nevertheless, this mortar was 300 years old.

We may conclude from all this, that the setting or solidification of the lime in a mass is occasioned by two causes: 1st, by the action and by the adhesion of the water to the particles of the lime, an action and adhesion which causes a hardness by so much more great, as the film of water which separates these particles is thinner; 2dly, by the combination of a substance, the *alyudor*, which destroys the dissolving action of the water on the hydrate of lime. This substance, when the limes are exposed to the action of the air, is, in a great number of cases, the carbonic acid; and when they are placed beneath water, one or several earths, united sometimes to metallic oxides. In some cases these two actions, that of the carbonic acid and of the earths, act together. When the carbonic acid acts by itself, it drives off the combined water and occupies its place. When the carbonic acid acts in conjunction with different earths, it is probable that its action is not so great, and that all the water is not displaced by it, as may be seen in the experiments of M. John.

This lime, which remains free, which we consider as being solidified by the water of cohesion, M. John considers, on the contrary, as being combined with the other

earthy matters, and as forming a substance analogous to feldspath; it is this combination which he regards as the true *cement*, and which we call *alyudor*. Builders and men of science will decide between this opinion and that which we have given.

On the colouring matter of Coffee. From *Revue Encyclopédique.*

On repeating the fine experiments of Brugnatelli on the colouring matter of coffee, M. Bizio, of Venice, observed, that when a drop of infusion or decoction of the berry fell upon cloth, it formed a yellow stain, surrounded by a border of a fine green colour, which he attributed to the oxydizement of the oil contained in the berries. To fix this colour, he boiled a hectogramme (nearly two pounds and a quarter) of coffee in powder, and reduced the decoction to eight hectogrammes. To this he added an equal quantity of sulphate of copper, dissolved in water, and employed as a precipitant a solution of caustic soda. The deposit which formed weighed 105 grammes (= 1622 grains), and on drying it in the air he saw it acquire a green colour, which was so much the more brilliant as the substance was more moist at the moment of its exposure to the free air. M. Bizio has proved, by many experiments, that neither water, ether, alcohol, nor the alkaline subcarbonates, have any effect on this colour. Caustic potash turns it sky blue. Soda does not alter it at all; and no acid, with the exception of the sulphuric and oxalic, destroys the colour entirely. By dissolving his substance in acetic acid a green tint is obtained, the beauty of which is still greater.

NOTICES OF NEW PATENTS.

Patent granted to WILLIAM LEAHY, *of Great Guildford-street, Southwark, engineer, for improvements in the machinery or apparatus for making bricks, and for certain improvements in the drying of bricks by means of flues and steam.* Dated 11th Nov. 1824.

MR. LEAHY'S apparatus for making bricks may be divided into four principal parts; 1st, That in which the clay or brick-earth is worked up and pressed forward; 2d, That which receives it from the first part and presses it into the moulds; 3d, A large vertical wheel that contains the moulds on its edge, receives the clay into them, and by machinery inside forces it out again, after being moulded upon boards that are passed beneath its lower edge; and 4th, Endless chain bands that carry forward these receiving boards from the rest of the apparatus, and which receive their motion from two polygonal wheels round which they are passed, placed with their axles in a horizontal plane, and parallel to each other, beneath the moulding wheel.

The first of these divisions consists of a conical vessel of cast iron, with a vertical shaft turning round in its centre, from which flat knives or cutters project at right angles in several parts, so as to pass near other cutters that project from the sides of the conical vessel horizontally towards the centre, which part of the apparatus is in common use in the potteries, and also for making mortar in many places,; in continuation of this vertical axle, a second one is placed so as to turn independent of it, on which, at the bottom of the conical vessel, is fixed a helical plate, forming a portion of a flat screw by which the clay is driven downwards with considerable force, after being well worked by the cutters in the upper part of the vessel, which cutters turn round fifteen times in a minute, while the spiral plate only makes five revolutions

in the same time, and those in the contrary direction from that of the cutters.

The second division, into which the clay is forced from the first, is a sort of box, whose sides are segments of circles, to which the two sides of the moulding-wheel apply closely in front for the greatest part of their extent; the rest of its face next the wheel that is not closed by it, being cased up so as to join the bottom of the conical vessel; a portion of the back part is also in a similar manner cased up to this vessel, but its lower part is occupied by a moveable diaphragm or shutter, which is jointed below in front next the moulding-wheel, and whose upper part works back and forwards between the sides to and from the wheel alternately, which motion it receives from a rod moved by a crank, that is turned round by the general machinery that gives the required motion to the other moving parts; this diaphragm presses the clay into the moulds at the edge of the wheel, as they pass by it in succession; and to prevent the clay from passing out behind it, when it is pressed towards the wheel, a segment of a hollow cylinder, or cylindrical plate, is placed at its top, which, fitting close to the back of the box above it, prevents any thing from passing out in that direction.

The third division, comprising the moulding wheel, is the most complicated; round its edge as many moulds are placed as its circumference will permit, separated from each other by triangular or wedge-shaped pieces, with their edges turned to the centre; in each of these moulds, a square piston, that fits it exactly, is moved once up and down in each revolution of the wheel, by a rod that passes from it towards the centre of the latter; the upper part of each of these rods is turned outwards at right angles from the side of the wheel, at which portion of it, two rings are attached that are concentric with it, and one being larger than the other, are placed at such a distance asunder as is required for the motion of the said rods to and from the

centre of the wheel, they acting as stops to the rods for confining their ends within the required limits; to move these rods and pistons from the centre towards the clay-box and compresser, a smaller wheel is fixed close by the side of the large wheel a little below its centre, in whose edge are formed cavities that, as it turns round, receive in succession the bent arms at the top of the rods; and moving in the same direction as the large wheel, must of course give them motion in the direction required, whose speed and degree will be regulated by the relative velocity of the two wheels in their revolutions; the other motion necessary for these pistons, from the circumference towards the centre, is given in a simple manner by a piece shaped like a long curved wedge with the point upwards, fixed near the side of the large wheel in the frame-work, so as to lie with its point near the outer ring above mentioned, and its base near the inner ring, in which position it must act on the bent arms of the pistons, as they pass by it, so as to draw them from the outer ring to the inner one, or towards the centre. A flat scraper that passes along the bottom of the clay-box towards the edge of the wheel, completes the junction of this last division of the apparatus with that before described; its use is to confine the clay at the bottom of the box, and scrape back into it from the bottom of the moulds whatever part is superfluous, and also to shape it smoothly at that part of the moulds; it is pressed towards the wheel by a strong spring at each side of, and is supported by a pair of rollers to facilitate its motion.

To the description of the fourth division of the apparatus already given, nothing need be added but that the polygonal wheels, which carry the endless chains, or chain bands, are placed in the plane of the moulding wheel, and convey the boards which receive the moulded clay, or raw bricks, to some distance from the whole apparatus, where they are taken off by hand and conveyed to the drying-house.

The moulding wheel has been described as making only a single row of raw bricks at once; but it is plain that two or more rows of them may be formed at the same time in the manner mentioned, by proportionably increasing the number of the moulds, and of the pistons, and other parts connected with them.

The machinery, or mill work, which gives each of the moving parts of the apparatus its proper motion, is all connected with one first mover, and may be impelled by any power most convenient; it consists of a bevelled tooth-wheel attached to the moulding-wheel, and of the same diameter, and of other similar wheels of sizes proportionate to the effects intended for them, connected with the other wheels and axles described, by shafts and pinions placed in suitable positions; but for a more particular description of the exact size of each wheel, of its number of teeth, and of the precise measurement and position of each part, reference must be had to the figures of them in the drawings that accompany the specification at the enrolment office, without which any attempt at conveying a farther idea of them would not be very intelligible.

The improvements in drying bricks mentioned in the title, refer to two methods for the purpose, the first of which is to place them sufficiently apart from each other on shelves, in a drying-house properly constructed, which house is heated by hot air passing in flues either of brick or iron beneath the raw bricks. In the second method horizontal steam pipes are used, at a certain distance from which other pipes are placed parallel to them, for conveying back the condensed water to the boiler, and between the two sets of pipes, others pass at certain intervals at right angles to them, in groups of 5 or 6 together pretty close to each other, over which groups of hot pipes stages are fixed, on which the raw bricks are arranged for drying, as on the shelves; proper spaces are left between the stages for passages, and the chain bands that convey

the raw bricks from the apparatus for moulding them, are described as bringing them close to the drying-house. The steam boiler for supplying the pipes, it is stated, may be either outside the drying-house or within it, as is judged most convenient; and after the bricks are sufficiently dried, they are to be burned in clamps or kilns, whichever is preferred.

The patentee expects great advantages from this mode of drying bricks in wet seasons, and from the facility it affords of making them in winter.

More than twenty years since Mr. Hudson, an American, obtained a patent for machinery for making bricks, which contained the conical vessel, cutters, and revolving spiral plate, of this apparatus. Many persons in the vicinity of Somers' Town, near which one of them was put up, may remember seeing it at work. It had not the moulding wheel, or the other parts already described, whose place was supplied in a simpler manner. Mr. Leahy's more complicated machinery would seem more effectual and complete for the purpose, particularly if it receives the very necessary addition of a contrivance for sanding the moulds on the moulding wheel, without which no perfect bricks could be formed by them; and no directions whatever are given on this essential matter in the specification.

The system of brick-making, much as it is practised, appears to be very imperfectly understood. Nothing can be more variable than the consistence of those brought to market here; some of the yellow-grey stocks (which come from the country) are as hard and firm as Portland stone, while other sorts are so friable as to be broken to pieces by very slight blows. It seems from this and other circumstances, that little care is taken in selecting materials for them; and that it is in general the convenience of having them in a certain place that causes them to be made there, and not the fitness of the earth found in that place for the purpose, which ought to be a primary con-

sideration. The defects of common bricks seem mostly to arise from a want of clay (alumen or argil) in their composition, and from the mode of burning, or rather baking them, not being sufficiently perfect. Some cart loads of the coarse clay found near the river below London, and in other parts, added to the earth used for each clamp of bricks, together with such other additions as might be pointed out by a more exact examination of that earth, by any of the rough methods of analysis now so generally known, would probably be a useful and profitable remedy for the first cause of these defects; and for the means of obviating the second cause, some useful hints will be found in our last number.

Patent granted to SIMON BROADMEADOW, *of Abergavenny, Engineer, for a method of manufacturing and purifying inflammable gases by a mixture of atmospheric air.* Dated January 19, 1824.

IN the apparatus which is described in the specification of this patent, and in the accompanying drawing of it, intended to exemplify the methods used by the patentee for the purposes stated in the title, two gas ovens or retorts, seven feet long and five feet broad, are constructed, with fire-places beneath them, both furnished with doors or stoppers, of the usual construction. From these retorts pipes ascend to small vessels, 10 or 12 inches high, designed to condense the tar, from which other smaller tubes descend downwards back again into the retorts, to reconvey to them the condensed tar. One long horizontal tube, of 4 inches diameter, communicating with these two tar vessels, passes on from above the retort furnaces a few feet, and then bends downwards into a larger vessel, called the gas condenser, on the top of which is placed a pair of bellows, two feet long, and 16 inches wide, which communicates with it by a pipe that descends from the aperture of its valve or clapper. From the nossel of this bellows a pipe passes to the gas holder, and from its upper

part a handle is shown in the draft, projecting some length from it, by which it is worked. In each door of the retorts is a hole, stopped with a plug, which, when the retorts are charged, and the fires are lighted beneath them, are to be opened as soon as the gas is produced; immediately after which the bellows are to be worked, which will draw the gas from the retorts through the gas condenser, and force it into the gas holder or gasometer. The patentee then directs, that when *eight* parts of gas are drawn off, the fires are to be put out, and the doors of the retorts are to be opened, and the bellows to be still continued at work, till a quantity of atmospheric air be drawn through the retorts and the open doors, equal to a ninth of the whole quantity. These directions are not quite distinct; but the meaning obviously is, that, when the charge ceases to produce gas, the doors of the retorts should be opened, &c. as mentioned, and air should be drawn through them, and forced into the gasometer, equal to an eighth of the gas which it before contained. This proportion of air the patentee asserts he has experienced to have the effect of purifying the gas; and that the plan altogether admits of the retorts being made much lighter and cheaper, from the pressure of the expanded gas being by it removed from them, and also that it will render unnecessary the accurate stopping or luting of the retorts before customary, and make chinks or leaks in them of less importance.

The patentee, in this process, only calculates on an eighth of air being mixed with the gas; but it is evident that a much larger portion than that must be introduced by the plug holes of the retorts, which are specially directed to be left open from the first working of the bellows. When it is considered that a certain portion of atmospheric air, mixed with coal gas, will cause it to explode, the danger of this plan must be plain to every judgment, from there being no method suggested in the specification

of regulating the portion of air which thus passes through the plug holes.

From a sixth to a twelfth of coal gas, mixed with air, will cause explosions, the mischief of which has been but too often experienced. We do not, however, assert that there will be much danger if the limits prescribed, in which the gas would be eight times as much as the air, were actually observed; yet as this is not provided for in the specification, the risk to which the plan of the patentee is liable is obvious; but we presume, in carrying the invention into practice, the patentee has remedied this defect of the specification.

Patent granted to George Vaughan, *of Sheffield, Engineer, for an improvement or improvements on steam-engines.* Dated May 1, 1824.

An idea may be formed of Mr. Vaughan's steam-engine, by supposing the cylinder of a single steam-engine to be placed with its bottom upwards, and another similar cylinder to be fixed in the usual position directly upon it, so that the piston rods of both may be in the same vertical line. Each of these cylinders has its separate piston, and the two piston rods are connected together by two bars, which pass outside the cylinders, from the ends of a cross-piece on the extremity of one of the piston rods, to the ends of a similar cross-piece on the extremity of the other piston rod; the two pistons being previously so placed that one of them shall be near the open end of its cylinder, when the other is near the closed end of that in which it moves. A case is directed to be put over the two cylinders, to confine the heat, and the openings between this case and them at each end are to be closed, so as to exclude the air. A pipe, furnished with a cock, is to pass from the steam-pipe, near where it enters the valve box, to the inside of this case, to convey steam into the space between it and the cylinders when the cock is opened, to keep the cylinders hot; and from the lowest part of the

case another pipe passes out, furnished also with a cock, to let off the water formed within the case by the condensation of the steam. The bars which connect the two piston rods pass through tubes of copper or other metal, placed vertically between the case and the cylinders, and fastened at each extremity to the ends of the case so as to be air-tight.

The valve box is fixed at the junction of the two cylinders, and in it a sliding valve is used, having a cavity within it, which, as it is moved up and down, alternately forms a communication between the passages that lead to the two cylinders, and those which go to the steam-pipe and to the condenser, the rod which works this valve passing through a stuffing box at the top of the valve box. The beam of the engine is to be connected with the piston rods by the links of the parallel gear being joined to the upper cross-piece, that unites the piston rod to the vertical bars. The valve rod is to receive its motion from some of the working parts of the engine in the usual manner, and the boiler, and all other parts not particularly described, are also to be constructed as shall seem best to the engine maker. Nothing more being peculiar to this engine, except a pipe for conveying oil above the lower piston, which passes through the case and the lower cylinder near where it joins the upper one, and which is furnished with a cock, and a small upright tunnel at its outer end, to receive the oil.

The patentee mentions that the cylinders of this engine and the case may either be all cast together, or in separate pieces, to be afterwards united, and that the partition between the two cylinders, where they meet, may be cast with them, or be made separate and bolted in afterwards.

We apprehend this engine would be much more expensive than a double engine of the usual construction, from requiring twice the length of cylinder (which is the most costly part) to produce the same effect; and it would also, we believe, waste the heat considerably more, from the

air extinguishe the cylinders alternately; as the pistons approached the juncture, and cooling them according as its temperature was below theirs. The hollow sliding valve, which is the best thing in the engine, appears to be precisely the same invention for which Mr. John Dickson obtained a patent in March, 1808, the specification of which was inserted in our 13th vol. second series, p. 159.

Patent granted to JOHN VALANCE, *of Brighton, Esq. for an improved method of carrying off caloric or fluidity from, and congealing, water, and it may be other liquids; also an improved method of producing intense cold; also methods of applying this invention so as to make it available (to purposes) with reference to which temperatures about freezing point may be productive of advantageous effects, whether medical, mechanical, or chemical.* Dated August 28, 1824.

MR. VALANCE, in the beginning of his specification, gives a history of the method of freezing water by the action of the air pump in accelerating evaporation, which concludes by notice of Mr. Nairne's discovery, that sulphuric acid would speedily absorb the vapour so produced, and of Professor Leslie's application of this discovery to produce a degree of cold sufficiently intense to consolidate mercury. By Mr. Leslie's method, only a small quantity (not more than a pound) of ice could be procured at once, as the process of freezing the water through the crust of ice at its surface was necessarily slow, from ice being a bad conductor of heat, and from its impeding the evaporation of the water. Mr. Valance's plan is intended to remove these defects, which he proposes to do by causing a current of highly rarefied air to pass over a surface of water, which is perpetually renewed by fresh additions in proportion as it freezes, in an apparatus on the same principles as Mr. Leslie's, but on a much larger scale, and in which the sulphuric acid is made to expose a very extended surface to the air holding the evaporated water.

The apparatus for this purpose, described by the patentee, consists of a large air pump, more than a foot in

diameter, and about 8 inches high, to be worked by a suitable power; beneath which is placed a cylinder, which is connected to its bottom by flanches and screws. This cylinder is open at bottom to admit another cylinder, in which the ice is to be formed, and whose bottom projects beyond the first cylinder, and turns up 3 or 4 inches, so as to inclose it for that depth, and form a receptacle for mercury, to produce an air-tight joint between the two cylinders of a nature that will permit them to be separated with facility.

Through the middle of the bottom of this latter cylinder a metallic rod rises in an air-tight aperture, to near the bottom of the air-pump, and on the top of this rod is placed a flat circular dish, on which the water is made to fall in very minute streams from a pipe that conveys it from an exterior cistern, which pipe, at its end that is over the dish, is perforated with several extremely small holes for this purpose. Above this dish is the passage to the air pump, which terminates here in a low hollow cone, whose edges lie very near to the dish, and to which the latter may be approached or removed from it, by the rod which supports it being formed with a fine screw at its lower end, which passes through a nut in a stand beneath it, and having four handles projecting from it, just above the screw: it may by them be easily turned either way, so as to ascend or descend as required. From the top of the air pump a pipe passes to the bottom of a third vessel, in which the rarefied air is exposed to the action of the sulphuric acid; and from the top of this latter vessel another pipe descends, below the air pump, to the vessel in which the ice is formed; in consequence of which arrangement, and of the disposition of valves in the air pump, when this is worked the air is drawn through the vessel holding the sulphuric acid, and over the stratum of water on the plate in the ice vessel, and is passed round again to the first vessel; and thus circulates as long as the pump is worked, carrying off the vapour and combined heat from the water,

and depositing them with the sulphuric acid; by which means a coat of ice is soon formed on the plate, and continually accumulates as the water falls on it, the rod that supports it being lowered gradually by the screw as this takes place, to leave space for it by making the plate descend.

The vessel for the sulphuric acid is an iron cylinder, with a conical bottom, having the point downwards, lined with lead, and about the same size as the ice vessel. In it a number of round flint stones are placed (which are easily found on the sea shore), to increase the surface on which the acid is to be spread; and at the top of the vessel is a revolving pipe, to spread the acid over the flints, bent in an angle, one arm of which ascends up through the middle of the top of the vessel, where it terminates in a funnel, and the other arm circulates over the flints, dropping the acid on them through very small perforations in its sides. To give it which motion, a horizontal wheel is connected with it by an axis above the funnel, which is acted on by a vertical wheel, that is turned by the machinery which works the pump, or by hand, as desired. The pipe and funnel may be made of lead; but, to give the joint sufficient stiffness where it passes through the top of the vessel, it should be inclosed in a platina tube, working in another of the same metal.

From the conical bottom of this vessel a small pipe is to descend several feet downwards, bent upwards at its lower end, to retain in all cases a portion of acid, which is placed in a small vessel, to hold the acid that runs down over the surface of the flints. The length of the pipe must depend on the degree to which the air is to be rarefied, since, if a perfect vacuum were to be formed, it must be more than 31 feet long to allow the acid to pass out freely. The acid may be raised from its receptacle to the funnel in various ways, but Mr. Valance prefers an Archimedes pump of lead for this purpose. To make the apparatus more perfect, thick glass lenses are cemented air-tight in

the sides of the ice vessel, nearly on a level with the part where the ice is to be formed, through which lenses the state of accumulation of the ice may be seen, in order that the dish may be lowered accordingly. And in order that the ice may be compact and free from bubbles, the water is to be previously boiled, or in some other manner freed from air, before it is put into the cistern to be conveyed to the ice vessel; to regulate its flow into which, the pipe through which it passes has a cock attached to it near its lower extremity.

Mr. Valance describes two or three variations of the foregoing apparatus, in one of which, plates of glass, 3 feet long, and 4 or 5 inches broad, are substituted for the flints, as a medium for giving an expanded surface to the acid. These plates of glass are arranged upright between two hollow cylinders, with their planes in the lines of the radii, and the acid drops down on them from a revolving tube, similar to that before described. In another of the variations, in place of the single low conical termination to the tube that passes from the ice vessel to the air pump, over the dish on which the water falls, there are seven smaller ones, six of which form a circle round the seventh, each having a separate tube passing to the air pump, by which disposition it is supposed the passage of the rarefied air would be more rapid over the wet surface of the dish or ice beneath, than in the first method. In both ways Mr. Valance calculates that the velocity of the air in passing over would be very great, and that the rapidity with which it would carry off the caloric along with the vapourized water would be proportional.

In order to produce cold below the freezing point, Mr. V. directs that the flow of the water into the ice vessel be stopped for some time after the ice is formed, and only be admitted at intervals, by which means the rarefied air will act in vapourizing part of the ice itself, and thereby will reduce its temperature still lower. To an apparatus managed in this latter mode, he directs what may be

called a cold closet to be attached, in which the various compositions designed for ices for table might be placed.

Of the useful purposes, mentioned in the title, to which Mr. V. proposes to apply this improved method of freezing, the mechanical are the most particular, the medical consisting merely in procuring iced drinks for fever patients in hot climates, and the chemical being barely noticed in general. The mechanical application consists in using the apparatus as a refrigerator, for an engine of similar construction to a steam-engine, but in which the expansion of ether by heat, and its contraction by cold, is to produce the power instead of steam; and Mr. V. states, that as sulphuric ether boils at 98°, and muriatic ether at a much lower temperature, that a small addition of heat would cause the piston of the engine in which they were used, to raise 80 lbs. on each square inch of its area. The objection to this plan would be, the great expence of the ether, particularly of the muriatic ether; but Mr. Valance thinks that it is most probable that the whole of it would be recovered by the use of his freezing apparatus, so as to serve repeatedly in the engine, without any material loss, particularly if no chemical change was produced in it by the operation; and though sensible of the uncertainty that must attend untried projects of this nature, and of the objections to it, he concludes by giving his opinion that ether might be applied profitably in this way as a mechanical impeller.

The most material circumstances in Mr. Valance's very voluminous specification (which covers twelve skins of parchment) have been here recited; but of course there are some particulars of less consequence which we have omitted for the sake of brevity, such as the mode of rarefying the air that was to circulate in the apparatus; another variation of the latter, in which the external air was admitted occasionally, and the air that had been operated

on given out; and a method of forming the valves of the air pump by oiled silk fastened round rings of wire.

It is easy to perceive that from the expensive nature of the apparatus, that it could never come into competition with the mode of freezing by ice preserved in ice houses so as to afford profit; and even in hot climates, where ice is not formed naturally, it would sometimes have to contend with methods which the natives practise to form it artificially, of some of which an account may be seen in the Annual Register, as they are practised at Calcutta, Allahabad, and other places in the East Indies. Besides, the apparatus described by the patentee could not act long, on account of the corrosion which must take place in all its working parts where lead could not be applied, from the air taking up a portion of the sulphuric acid, and conveying it into the air pump and most other parts; and to line the whole of the working parts with platina, especially when made on the large scale proposed, would produce an expence that few would choose to encounter for an object of so little apparent benefit; but in thinking it to be so we of course differ widely from the patentee, who has thought it worth the cost of two patents, the present being the second which he has taken out for his methods of producing cold. Indeed, we might venture to predict, that no profit can ever arise from the mode of freezing by sulphuric acid, however improved or modified; and that if any of the plans mentioned by the patentee should come into use, it would be that in which a current of air, passed over ice, was made to reduce the temperature of his cold closet, but with the condition of omitting the sulphuric acid altogether.

If, indeed, water could be frozen without the use of acids or other expensive mediums (which would at least require coals, labour, and chemical skill to prepare them for use, repeatedly), the means which it would afford of procuring fresh water at sea would alone make it of the greatest consequence; but the methods of freezing pro-

posed in this specification are neither applicable to this purpose, nor do they afford any clue which might lead to it, though we have still reason to hope for its attainment from other processes of which we have some intimation, and which have not yet been made public.

Of the utility of the mechanical application of ether as a power for giving motion, we have still less expectations; for, exclusive of the objections to its cost, and the very great improbability of the apparatus of the patentee condensing it completely, when once rarefied, the nature of its composition and the action of the metal of the apparatus on the acids which necessarily enter into it, would soon so far decompose it, and alter its nature, as to destroy those qualities which would make it valuable for the use proposed.

Patent granted to William Henry James, *of Coburg Place, Winson Green, near Birmingham, Engineer, for an improved mode of constructing steam-carriages for highways.* Dated May 15, 1824.

The steam-carriages described in this specification are intended solely for common roads. Instead of the former method, of using one steam cylinder, or at most two, for each steam-carriage, the patentee directs that a steam cylinder shall be used for *each* wheel, and in his draft, in fact, two cylinders are represented at each extremity of the two axles, so that eight steam cylinders will be required altogether for this plan.

These cylinders the patentee states are to be very small, but does not mention their precise dimensions; and as the pistons of each pair of them are arranged to operate so on the cranks with which they are connected, that when one is vertical the other will be at right angles to it, to save the use of fly wheels, every pair may be considered as one engine acting on the wheel which it is intended to move. These cylinders are placed beneath the axles of the carriage, and the cranks are fixed above

them, and each of these cranks is furnished with a spur wheel, which, by another wheel of the same sort, acts on a toothed ring, attached to the nave of the carriage wheel, which nave turns freely on its axle. From these cylinders pipes run to the steam boiler, on which cocks are so placed that, by turning them in certain directions, the steam may be let on or shut off from each pair of cylinders as required, and also may be admitted partially sometimes; by which means each wheel can have its degree of velocity regulated in respect to that of the others, as may be best suited for making the carriage turn round a corner, or move in any curve desired.

The steam boiler is placed beneath the perch, near the hind wheels, and the chimney still further back, together with the seat of the engine-man, who not only keeps up the fire, but, by handles placed near him, which communicate with the cocks before-mentioned, can stop either of the hind wheels or diminish their motion, as may be most suitable to the slope of the hills, in descending which locking of the wheels might be necessary. The engines used with these carriages are to be of the high pressure species, so that the steam might be discharged from the cylinders at once after being used; but to obviate the inconveniences which this would cause, pipes pass from them to the chimney, to carry off the waste steam along with the smoke.

The front axletree is made to turn on its centre as usual, and the steam pipes on it have joints at the centre of motion, similar to those of cocks, to admit of their being turned along with it; a segment of a horizontal toothed wheel is attached to this axle, in which a pinion works, from which a vertical shaft ascends to the seat of the director, which is placed directly above it, and is constructed like a coach-box. On the top of this shaft a horizontal wheel, furnished with handles like the steering wheel of a ship, is fixed, by which the director can turn the front axletree as the curvature of the road may require. Hori-

zontal rods are also so arranged between this axle and the cocks, that in proportion as it is turned the steam may be shut off from the cylinders at the side next the centre or centres of the curvature of the road, by which means the wheels at that side move more slowly than the others. Besides the steering wheel, there are two levers with handles, placed near the seat of the conductor, which communicate by cranks with the rods just mentioned, by which the cocks are turned, and by moving which he can either diminish the motion of the wheels at one side, as he pleases, or stop off the steam from all the cylinders at once, when it is required to stop the progress of the carriage.

Two bodies of coaches are represented in the drawing, placed above the axles in the usual position for double-bodied carriages; and both their arrangement, and that of the parts of the steam-engine not particularly described, is directed to be such as is commonly used in similar cases. The specification concludes, after this, with the usual clauses relative to variations of parts, and the particularisation of the claims of the patentee.

With respect to this plan of Mr. James's, a question arises whether the multiplication of cylinders, which it directs, may not add more to the weight by their number, than what their small size may admit of its being diminished in each of them, from the greater strength which this reduction of size causes in proportion to their substance. There should also be taken into this account, that the weight of many wheels and of some heavy shafts are saved by this plan, which are necessary in those others for the same purpose lately made public, as may be more clearly seen by comparing it with that of Messrs. Burstall and Hill, given in our third Number.

Mr. James has on this occasion fallen into the same error as Messrs. Burstall and Hill, in placing the seats for the passengers, and the receptacles for the luggage, &c.

on the same wheels with the steam-carriage, by which accumulation of weights a degree of pressure must be caused on the wheels, so great, that no common road could bear it without speedy destruction.

As this is a very important point of consideration with respect to steam-carriages, we beg leave to refer to the observations, which we have already made respecting it, at the conclusion of the account of the patent of Messrs. Burstall and Hill.

Patent granted to Jacob Perkins, *of Fleet-street, London, Engineer, for certain improvements in propelling vessels.* Dated August 9, 1824.

In Mr. Perkins's method of impelling vessels, flat paddles or impellers, like the blades of oars, are made to revolve behind the stern of the vessel in a plane, at right angles to the keel; and, from being sloped so as to form *inclined planes* to the line of impulse, they tend to move the vessel in the opposite direction to that in which their faces act on the water. To prevent the oblique impulse from turning round the vessel, two sets of these paddles are made to move in opposite directions at the same time, and are of course attached to separate axles, which, to prevent any projection of the paddles beyond the sides of the vessel, are made to revolve concentrically by one of them being hollow, and the other passing through and turning round within it.

On each of these axles Mr. P. only employs two paddles, opposite to one another, whose slopes or inclined planes are so curved, that close to the axle they form an angle of 45° with it, while at their extremities the angle of inclination is 22½.

One end of the solid axle, on which the other is sustained, lies inside the stern, and its other end is supported by a cross piece, that rests on the ends of two long levers, which run along the sides of the vessel, and turn on pivots,

placed exactly in a line with the inner extremity of the solid axle; which axle is supported by a cylindrical piece of metal, capable of moving in its socket or bed, so as to admit of the outer end of the axle being raised or lowered by the motion of the levers and cross bar; by which operation the depth to which the paddles shall descend into the water is regulated.

To receive the requisite motion from the steam-engine, or other moving power, the solid and the hollow shaft have each a mitre wheel at their inner extremities, near the cylindrical piece by which the former is supported, and through which it passes a few inches, to allow of the mitre wheel at its end being at the same distance from the cylindrical piece as the wheel on the hollow axle is at the opposite side. Two other mitre wheels are placed at right angles to those, with their teeth mutually interlocking, but turning freely on their axles, the ends of which move in the cylindrical piece that sustains the solid axle of the paddles. On the same axle with these two latter mitre wheels, two spur wheels are fixed, which connect the axles with the moving power, and which, while they turn round with those axles, are capable of being moved sideways to or from the last-mentioned mitre wheels, so as to be united or separated from them as required, by projecting pieces attached to them for that purpose, in the manner common in mills for similar effects. A metal frame passes outside those spur wheels, and moves in grooves in the bosses which connect them with the axles, so that when it is drawn to one side, by a screw placed there for that use, and turned by a winch, the mitre wheel at the opposite side is joined to the moving machinery, and the other one turns loosely in the axle; and when the screw is turned the other way, the mitre wheel that was before loose comes into action, and that formerly in action becomes loose; by which means the direction of the motion of the paddles may be quickly reversed, and the vessel made to go back or forward as required.

Mathematicians have long been in favour of impelling vessels by inclined planes, and in 1752 Daniel Bernouilli obtained a premium from the Academy of Sciences at Paris, for a method of doing this by *rotary inclined planes*, accounts of which, and of some others, may be seen in the Retrospect of Philosophical Inventions, &c. vol. i. p. 243. We are inclined, however, to give the preference to Mr Perkins's plan, from its superior practical arrangements; but feel somewhat apprehensive, from the drawing, that he places the two sets of paddles too close together, by which the action of one set on the water may be diminished by that of the other set.

Patent granted to ALEXANDER NESBITT, *of Upper Thames-street, London, Broker, for a process by which certain materials may be manufactured into paper or felt, or a substance nearly resembling coarse paper, which is applicable to various purposes.* Communicated by a Foreigner. Dated July 27, 1824.

The material which the patentee applies to the purposes mentioned in the title is *moss*, which he describes "as being soft like wool, and being gathered in the *watering* places, ditches, and low grounds of Holland;" and the method directed for converting it into the substance stated, is to chop it in a machine for chopping tobacco, till it is reduced to pieces half an inch in length, after being previously well washed to free it from dirt, and then dried. The moss, when thus chopped, is to be left to soak for some hours in a tub of water, from which it is to be removed into a tub or vat, such as is used by paper-makers, whence it is to be taken up by common paper moulds, in the same manner as the pulp for making paper, so as to form a leaf or sheet. Each leaf so formed is to be placed between woollen cloths, and when a sufficient number of them are prepared, they are to be pressed altogether in a very strong press. They are after this taken out and

placed on cords in the drying loft, and when thoroughly dry, they are again pressed between sheets of brown paper, and left in the press for three or four hours; after which the sheets are fit for use.

This material or moss paper, the patentee states, that he principally intends using for ships "between beam and plank," by which we suppose he means for sheathing paper, or the coarse paper commonly put between the sheathing and the planks of vessels. He further mentions, that great use is made of this moss in the navy and merchants' ships of Holland, for putting between the planks and the copper sheathing, where it is found to be very serviceable, and never rots.

The moss paper, he asserts, thus employed, would swell up as soon as it became wet, and would thus serve to prevent leaks. He thinks the moss for this purpose might be found in sufficient abundance in England; but if not, any quantity of it might be easily imported from Holland.

This process was communicated to the patentee by Mr. Wm. Van Houton, of that country.

As moss is little affected by wet, the soaking it in water for the time mentioned, after chopping, can have no effect in macerating it, as it has on linen rags, so as to fit it for making real paper; so that all that is performed by the process is, to produce sheets of moss strongly compressed, but having very little adherence between its fibres. It is, however, very probable, notwithstanding, that it might be very serviceable for the use pointed out by the patentee.

Much use is made of moss in caulking the large boats used on the Rhone, in performing which operation the method used is curious and singular. The moss thus used keeps the boats very staunch, though their shape is

not well calculated to prevent leaks, they being both flat-bottomed and wall-sided. It lasts a long time there in the fresh water, and from the account of the patentee, the moss used in Holland is equally durable in sea water.

It is to be regretted that the patentee has not mentioned in his specification the botanical name of this moss, as his description of it is, from this omission, not so complete as could be desired. The moss used for the boats on the Rhone runs in length from two inches to three and a half inches, consisting of fibres of those lengths, closely surrounded from top to bottom by a pile, or tufts of a velvetty substance, about the eighth of an inch in length. From the description of the sphagnum palustre we should imagine, that if this moss is not exactly the same, it is at least of the same genus.

We must also notice, that the specification of this patent, having been evidently drawn up by a foreigner, contains some peculiarities in the language, which it might have been as well to have previously corrected.

The moss paper of the patentee seems very likely to have the beneficial effect which he mentions, when used under the sheathing of ships; and we therefore think it entirely deserving of a fair trial by ship-owners for this purpose, if they can prevail on their ship-builders to make the experiment.

LIST OF NEW PATENTS.

Thomas Steele, of Magdalen College, Cambridge, Esq. for improvements in the construction of diving bells or apparatus for diving under water.—Dated October 28, 1825.—Six months to enrol specification.

John and Samuel Seaward, of Poplar, Middlesex, engineers, for a new or improved method or methods of propelling boats, craft, and all kinds of vessels, on canals, rivers, and other shallow waters.—Dated November 1, 1825.—Six months to enrol specification.

William Ranyard, of Kingston, Surrey, tallow chandler, for a circumvolution brush and handle.—Dated November 1, 1825.—Two months to enrol specification.

Vernon Royle, of Manchester, silk manufacturer, for improvements in the machinery for cleaning and spinning of silk.—Dated November 1, 1825.—Two months to enrol specification.

John Isaac Hawkins, of Pancras Vale, Middlesex, civil engineer, for improvements on certain implements, machines, or apparatus, used in the manufacturing and preserving of books, whether bound or unbound.—Dated November 1, 1825.—Six months to enrol specification.

John Ridgway and William Ridgway, both of the Staffordshire Potteries, manufacturers of china, stone, and earthenware, for an improved cock tap or valve, for drawing off liquors.—Dated November 1, 1825.—Two months to enrol specification.

Thomas Seaton, of Bermondsey, Surrey, shipwright, for improvements on wheeled carriages.—Dated November 7, 1825.—Six months to enrol specification.

George Hunter, of Edinburgh, late clothier, for an improvement in the construction, use, and application of wheels.—Dated November 7, 1825.—Six months to enrol specification.

THOMAS SHAW BRANDRETH, of Liverpool, Esq. for an improved mode of constructing wheel carriages.—Dated November 8, 1825 —Six months to enrol specification.

SAMUEL BROWN, of Old Brompton, Middlesex, Gent. for improvements in machinery for making or manufacturing casks and other vessels.—Dated November 8, 1825.—Six months to enrol specification.

WILLIAM ERSKINE COCHRANE, of Regent-street, Middlesex, for an improvement in cooking apparatus.—Dated November 8, 1825.—Six months to enrol specification.

JOHN WILLIAM HIORT, Office of Works, Whitehall, architect, for an improved chimney or flue, for domestic and other purposes.—Dated November 8, 1825.—Two months to enrol specification.

CHARLES LOUIS GIROUD, of Lyons, in the kingdom of France, for a chemical substitute for gall nuts in all the different branches of the arts or manufactures in which gall nuts have been accustomed or may hereafter be used. —Dated November 8, 1825.—Two months to enrol specification.

JAMES WILKS, of Rochdale, Lancashire, tin-plate worker, and JOHN ERROYD, of the same place, grocer, for an engine for cutting nails, sprigs, and sparables, on an improved system.—Dated November 8, 1825.—Six months to enrol specification.

JOHN JAMES ALEXANDER M'CARTHY, of Pall Mall Place, Westminster, for new or improved pavement, pitching, or covering, for streets, roads, ways, and places. —Dated November 10, 1825.—Six months to enrol specification.

BENJAMIN COOK, of Birmingham, brass founder, for a new method of rendering ships' cables and anchors more secure, and less liable to strain and injury while the vessel lays at anchor.—Dated November 10, 1825.—Six months to enrol specification.

BENJAMIN COOK, of Birmingham, brass founder, for

improvements in the binding of books and portfolios of various descriptions.—Dated November 10, 1825.—Six months to enrol specification.

JOHANN GEORGE DEYERLEIN, of Mercer-street, Middlesex, smith and tool maker, for improvements on weighing machines, which machines he denominates German weigh-bridges.—Communicated to him by a foreigner.—Dated November 10, 1826.—Six months to enrol specification.

SAMUEL PARKER, of Argyle-street, Middlesex, bronze and iron founder, and WILLIAM FRANCIS HAMILTON, of Nelson-street, Long Lane, Surrey, engineer, for a certain alloy or alloys of metals.—Dated November 12, 1825.—Six months to enrol specification.

EDWARD BOWRING, of Goldsmith-street, London, silk manufacturer, and ROBERT STAMP, of Buxted, Sussex, weaver, for improvements in the working, weaving, or preparing silk and other fibrous materials, used in making hats, bonnets, shawls, and other materials.—Dated November 17, 1825.—Six months to enrol specification.

JAMES GUESTIER, of Fenchurch Buildings, London, Esq. for a mode or modes of making paper from certain substances, which are thereby applicable to that purpose. Communicated to him by a foreigner.—Dated November 17, 1825.—Six months to enrol specification.

ALEXANDER LAMB, of Princes'-street, London, Gent. and WILLIAM SUTTILL, of Old Brompton, Middlesex, flax spinner, for improvements in machinery for preparing, drawing, roving, and spinning flax, hemp, and waste silk; —Dated November 17, 1825.—Six months to enrol specification.

GEORGE BORRADAILE, of Barge Yard, Bucklersbury, London, merchant and furrier, for an improved method of making or setting up of hats or hat bodies.—Communicated to him by a foreigner.—Dated November 17, 1825.—Six months to enrol specification.

THE REPERTORY OF PATENT INVENTIONS, &c.

SUPPLEMENT—DECEMBER, 1825.

Patent granted to JOHN M'CURDY, *formerly of New York, in the United States of America, but now of Snow-hill, London, Esq. for an improved method of generating steam.* **Communicated to him by a foreigner residing abroad. Dated June 15, 1824.**

INSTEAD of boilers for producing steam, the patentee proposes to use tubular chambers, which being brought to a due degree of heat by any of the usual methods, water is to be injected into them by a forcing pump, through a pipe an inch in diameter, that passes along the centre of each, and has small perforations on every side, through which it is emitted in "*sprees*" or small streams against the inside of the chambers. The water being then converted instantly into steam by the heat of the chamber, the steam passes off by a tube at its other end, to work the piston of a steam cylinder in the common manner.

From the bottom of each chamber a pipe descends, furnished with a cock, by which may be known whether the whole of the water injected each time by the pump be converted into steam; the quantity of which, to equal a four or five-horse power, should be about "half a gill."

To add to the power of the engine the number of tubular chambers may be increased, together with the heat applied to them, and the portion of water injected. To cut off the communication between each separate chamber and

the rest, in case of accidents, cocks are added to the pipes where the water enters them, and where the steam goes forth.

In using these tubular chambers, at first the forcing pump is to be worked by hand, till the pressure of the steam is found to be what is required, after which the engine is set to work, and moves the forcing pump or pumps with the rest of the machinery.

The patentee divides his claims relative to this patent into three heads; the first of which comprises the tubular chambers; the second the mode of distributing the water evenly in them by the perforated tube; and the third the method of getting a "head" or pressure of steam before the engine begins to work.

We understand that the general size of the tubular chambers which the patentee has tried, is 11 or 12 feet in length, and about six inches in diameter inside, and that they are made of wrought iron.

Considering the degree of risk from all engines of the kind above described to be of primary importance, we must observe, that the water or steam coming into contact with the red-hot iron of the chambers used in Mr. M'Curdy's plan, will be in part decomposed, and form more or less hydrogen gas, which, on mixing with a proper portion of atmospheric air, will be liable to explosion. It is true this danger will not be very great where care is taken to blow all the air out of the chambers by the steam, as long as they continue sound; but it is one, however, which never should be forgotten.

We do not agree with those who think there will be any saving by using these tubular chambers instead of steam-boilers; on the contrary, knowing the great wear of substance which takes place in iron, when exposed to heat, without being in contact with a liquid (which in the ponderous pots used in making prussian blue is often at

the rate of two inches of their thickness from the outside in a month), we are inclined to suppose that the expence of frequently replacing the *burnt-out* tubular chambers would be much greater even in the first twelve months than the cost of boilers for producing an equal power of steam.

The patentee has not confined his transatlantic importations to machinery; he has also favoured us with a new word (spress), the propriety of which we much doubt, at least in the sense in which he employs it. Its slang meaning is capable of a more legitimate authority *we guess.*

Patent granted to William Johnson, *of Totham, Essex, Gentleman, for means of evaporating fluids; for conveying heat into buildings, for manufacturing, horticultural, and domestic purposes; for heating liquors in distilling, brewing, and dyeing; and in making salt and sugar, with reduced expenditure of fuel.* Dated August 5, 1824.

The specification of this patent describes four methods of effecting the purposes of its title. In the drawing representing the first method three pans are placed, one above the other, so that the bottom of the upper one forms the top of that in the middle, and the bottom of the middle one the top of that which is lowest. Flanches project from the top and bottom of the middle pan, and from the bottom of the upper pan, and top of the lower pan, which serve for fastening them together steam-tight, by screws and nuts. For the pans above the lower one, the bottoms may be formed by plates put in between the flanches, and made tight by the means mentioned. These pans are to be furnished with tubes for conveying in and drawing off liquors (which are not shown in the draft), and for passing off the steam to other vessels, which latter tubes are to have valves, by which the pressure of the steam in the pans may be regulated by weights, and all of them are to have cocks, by which the communications can be opened or shut as required. The steam-pipes from the pans, in the draft, pass off sideways into one common

tube, which enters a close vessel beneath an open pan, in which liquors may be boiled or evaporated by the waste steam of the others. The patentee states, that he has ascertained that a very large proportion of the steam at a high temperature may be thus conveyed off for useful purposes, after keeping up that of the pan from which it escapes to the degree of heat desired; and also that the heat of the lower pan being raised above boiling point by loading its valve, for instance, till the liquor in it is raised to 240° Fahrenheit, that in the pan above it may be brought to 230°, by the heat conveyed through its bottom from the former; and that in the upper pan to 214°, by the heat of that last mentioned. Of these pans the lower one is placed in a furnace, and exposed to the action of the fire in the usual method, and the upper ones receive their heat from it as described; and although only three pans are shown in the draft, placed as described, it may easily be conceived that a greater number may be arranged in a similar manner.

In the second method one large vessel, like the boiler of a steam-engine, is placed on the fire-place or furnace, in which several other flat pans, with close tops, are arranged one over the other successively, but with small intervals between them, to let the steam from the outside vessel act on all parts of them. For the admission of these pans, one of the ends of the outside vessel is so fastened on by flanches and screws and nuts, that it may be taken out when required. All these pans have pipes passing into them and from them, through the outside vessel, for the same purposes as those nentioned in the first method, and are furnished in like manner with cocks and valves; and the steam may be similarly conveyed from them to operate on other detached vessels.

The third method will be best described from the draft. In that three vessels are shown, one over the other, the top of the lower one forming the bottom of that in the middle, as in the first plan; but the top of the middle one and the bottom of the upper one being distinct, so as to

leave a small space between them for the admission of steam, which is conveyed into it from the lower vessel, on which the fire operates, by two pipes that pass up from the latter into it, along the sides of the middle vessel. From this middle vessel the steam goes off into the upper one by a pipe in its centre, which passes through the interval between them sufficiently high to rise above the liquor in the upper vessel; and from the top of this upper vessel another pipe conveys the steam from it where it is desired to operate.

The fourth method seems to be a combination of the first and second. In it the lower pan, which is exposed to the fire, contains one or more close shallow vessels, managed in all respects as those in the second plan; above them it has a close top, which serves as a bottom to an upper vessel, as represented in the draft; from all these vessels steam-pipes pass into a detached close vessel, as in the first method, on which an open pan is fixed for evaporating or other uses, and tubes also pass into them for conveying liquors into and from them, all which pipes are furnished with cocks, and those for the steam with valves, in a similar manner to the method first described.

In all the several methods the bottoms of the pans are to be sustained by ties, in the same manner as that used for the bottoms of steam-boilers, when they are large enough to require this precaution; room being left in them to put in and take out the keys by which the ties are connected.

How these plans of the patentee were to be applied to horticultural purposes, as stated in the title, excited in us some curiosity, which, however, was not gratified, although, from the great length of the specification, such information might have been expected. Its excessive length is, however, occasioned by incessant and useless tautology, instead of affording the desired explanations of the processes announced.

Various patents have been obtained previous to this for the application of steam to boiling and evaporating, of which a very useful one may be seen in p. 74 of our 44th vol. second series. The methods of the patentee, however, differ from them in the use of inclosed vessels as described.

This plan might be of service for liquors that left no sediment, or in which no salts crystallized, and which consequently required no passage to the pans for removing the salts, or for cleaning them out; but this proviso limits its use to such a narrow compass, as to render its benefit extremely problematical.

We cannot, for these reasons, conceive how the combined boilers can be at all used for preparing common salt or sugar, unless the steam from them be applied to act beneath open pans, which the patentee repeatedly disclaims as being within the limits of his patent; which he very properly does, the method having been before secured by former patents.

In short, the application of the plans of the patentee to useful purposes seems still a desideratum, which will so far secure the exclusive use of them to him, as no other person, probably, will be able to imagine or comprehend a secret so very profound, and so artfully concealed. We shall, however, just beg leave to mention in conclusion, that so far as these plans (if any) are secured by secresy, so far are they unprotected by the patent.

Patent granted to FREDERICK BENECKE, *of Deptford, Kent, Verdigris Manufacturer,* DANIEL TOWERS SHEARS, *and* JAMES HENRY SHEARS, *of Fleet Market, London, Coppersmiths; for improvements in making, preparing, or producing zinc or spelter.* Communicated to them by a certain foreigner. Dated October 7, 1824.

THE specification of this patent commences with pointing out the defects of the common method of making zinc, which consists of urging the ore by fire in a vessel, from the bottom of which a pipe descends into water, in which method the other metals, mixed with the ore, particularly

lead, are melted and pass down along with it in the state of alloy. It then describes an apparatus, by the use of which this evil will be avoided, and the zinc produced be more pure, by passing off from it laterally in the state of vapour before it is condensed into metal. This apparatus consists, in its most simple state, of a long narrow vessel, of the refractory clay, used in making crucibles, which may be either hexagonal, cylindrical, semicylindrical, or of various other forms, and which is to be placed horizontally in a furnace, for the reception of the ore. The front or mouth of this vessel is fitted with a stopper, towards the upper part of which is a circular aperture, for the reception of the neck of an earthen globular head; and towards its lower part a square aperture, for extracting the calx or remains of the ore after distillation, which latter aperture is furnished with a stopper, to be luted into it when the vessel is at work, as is also the primary stopper into the vessel itself. The globular head, besides the neck, has another tube, which descends from it, and which may be lengthened by luting additions to it till of a proper length for cooling the vapourized zinc, which falls from it as soon as condensed upon an iron plate, placed beneath for its reception. In the front of this head is a round aperture, through which the ore is put by a scoop into the vessel beyond it, which opening is fitted with a stopper, which is luted to it when in use.

Two sorts of furnaces are described for the vessels fitted up as mentioned. In the first, ten of them are arranged on one level hearth, supported a little above it by bricks, and placed in two rows, with their heads outwards, and the tubes depending from them. A small space is left between their inner ends, and in the middle of this space an oblong opening forms a communication with the fire-place beneath it, from which the heat and flame ascends, circulates through the vessels, and passes out above through openings in a low arch, which covers all the vessels, and forms a reverberator for reflecting down and confining the

heat. Under the grate of the fire-place the ash-pit communicates with a large culvert or arched passage, that admits the air from beyond the limits of the building; and through one of the ends of the mass of brick-work a sufficient space is left for access to the fire-place, to supply it with fuel. We have left the heads projecting from the vessels beyond the furnace or oven; but as it is expedient that they should be kept warm, a small cell or nitch is made for each of them, by building their walls between them, arched at top, and having metal plates across them, at the level of the bottoms of the vessels; through apertures in which plates the tubes from the heads pass down near to other metal plates at the level of the floor, on which the zinc is deposited as it is formed.

By this arrangement the head of each vessel will be in a small square cell by itself, joined by its neck to the stopper of the vessel for the ore, at which part the openings round the vessel are to be filled up by pieces of bricks and luting, to close the back of this little cell; and to its front a moveable door or lid is to be fitted, which, when luted in, confines the head entirely from view. This lid is composed of an iron frame, with iron wire passed across it in both directions, so as to form a sort of grating, which is to be plastered at both sides with luting; and in the middle of this grating a small opening is left, inclosed by a similar iron frame, furnished also with its stopper, which opening being opposite that in the head, serves to give access to it for putting in the charges of ore.

In the second sort of furnace the vessels are placed in several tiers, above one another, six or seven being in each tier. The necks of the heads or tubes serving for that purpose pass through the front wall of this furnace, which is built up of loose bricks and luting between the outer ends of the vessels. Beneath all is placed the fire-place, which is covered by a brick arch, to prevent the fire acting too violently on the lower vessels; and through it apertures are left, through which the fire ascends, and circulates

through the spaces left for it round the vessels. Over the upper vessels is a brick arch, with apertures in it to let off the smoke; and just above this arch is left a passage, through the wall in front, closed by a door or stopper, by which the apertures in this arch may be closed or opened as required. The method of arranging the heads and distilling tubes in this latter furnace is not described.

The apparatus being thus prepared, black jack, blende, or sulphuret of zinc are taken, and roasted either in a roasting furnace, or else stratified in alternate layers with fuel, and roasted by setting fire to the pile. The ore is then spread out in the air, watered, and lixiviated, to separate the sulphate of zinc; after which it is roasted a second time, and then powdered fine, and mixed with an equal portion of powdered coal, charcoal, sawdust, or other carbonaceous matters, particularly with cinders, and then by scoops put into the vessels through the doors of the nitches and the heads, as mentioned, to the thickness of an inch or two. Calamines, or oxides of zinc, only require the latter part of this process. The openings being then all luted, the first charge is to be distilled as long as the zinc comes from it; then a second charge is to be put in, and managed as before; and after that other charges successively, as far as the vessels will hold them, so as to perform the work to advantage. After this the doors of the nitches are to be opened, the heads to be taken down, and the calces and residuums from the ore to be drawn out through the square openings in the stoppers, in the front of the vessels. And then again, the heads, doors, and stoppers being placed as at first, the operations described are to be repeated as before.

The patentees state that much depends upon regulating the fire, so as to keep up a regular heat at the same temperature throughout the process; and this they effect by putting the coals into the fire-place in small quantities at a time, frequently renewed; also by having a large culvert to admit the air evenly, without any quick draft or blast;

and by letting the smoke escape through apertures in the arch of the oven or furnace for the same design, without using any chimney to accelerate its current. They also mention that they use, in some cases, pearl-ash or sea salt, or slaked lime, along with the powdered ore and coal in distillation, for the purpose of increasing the produce of zinc.

The construction of the receivers, heads, and tubes, their mode of arrangement and connection, and the structure of the furnace first described in this specification, are all evidently the work of some person of great experience in the large operations of chemistry, and contrived in a masterly manner. Of the second furnace we can only say, that in our opinion the patentees had better have said nothing about it than to have left the most difficult part of the arrangement respecting it undescribed, which leads to the supposition that they had in fact never perfected the mode of its application.

The lateral method of distilling zinc, claimed by the patentees as an improvement of their invention, will, we apprehend, be a point very difficult for them to maintain, since Mr. W. E. Sheffield, in the specification of a patent he obtained several years since, for separating metallic substances from their ores, describes the use of lateral tubes from his pots, for letting the zinc pass in that direction in the state of vapour to the place in which it is to be condensed. We have also to observe, that the same process has been long practised, even before any of these patentees were in existence. In fact, so many have been the methods in which vessels of all shapes and kinds, and in all positions, have been used in chemical processes, and particularly in those relating to metallurgy, that we apprehend it would be most difficult to contrive any which had not been before employed.

It has been acknowledged by the first chemists, that the present mode of getting zinc from the ore is very defective.

We have still the same complaint to make, as the processes of the patentees by no means tend to remove it. In the roasting the sulphurets, as directed, much of the zinc must be lost, and in this part of the business at least no improvement has been attempted. As to the employment of pearl-ash, sea salt, or lime, which the patentees mention, with ore prepared as they state, we may be well excused in doubting its advantage; they not having explained it, and there being no chemical theory, ancient or modern, which would lead us to expect the smallest benefit from the action of these substances on the ores of zinc, in conjunction with carbonaceous matter, exposed to heat in the manner directed by the patentee. On the contrary, we should rather think them injurious, from their tendency to vitrify the oxides contained in the ore, and convert them into a slag instead of metal.

Patent granted to WALTER FOREMAN, *of Bath, Esq. Commander in the Royal Navy, for improvements in the construction of steam-engines.* Dated October 7, 1824.

THE steam-engine described in the specification of this patent is of the rotary kind, in which a vertical cylinder is to revolve within a fixed annular case, that encompasses it by the pressure of the steam on valves, attached by hinges to the cylinder, which are pressed close to it by a wheel projecting from a stop within the upper part of the case, and again move off from it by their weight when their hinges pass the horizontal diameter. The steam enters at one side of the case by a tube, and passes out at the opposite by a similar tube, after having acted on the valves.

The cross section of the annular case would form a trapesium, whose base next the cylinder would be longer than its top, towards which its two sides would slope in equal angles. The whole figure therefore of this case

would be, in strictness, at each side a very flat obtruncated cone; which conical figure would not be particularized here, so little is it perceptible, and so inconceivable is its use, but that it is set forth by the patentee as one of the chief points of *improvement* which he expressly claims. The valves must of course be shaped at their sides according to the section of the case just stated, which shape forms another particular claim; and they are also represented in the draft that accompanies the specification, as being curved in the other direction, or flatwise, so as to lie close to the cylinder when pressed down to it by the stop at the top. These valves are six in number in the draft, and are separated from each other by narrow cross pieces screwed to the cylinder, to which their hinges are attached. The stop is formed hollow, in two pieces, one of which slides downwards within the other, and both are fastened by screws within the case so as to be steam-tight; the sliding formation of the parts is to admit of occasionally lengthening the whole in the direction of the radius, to supply the wear of the side next the valves. From this stop a spring piece descends in the case to near the horizontal diameter, where it sustains a vertical wheel, that is nearly of the diameter of the section of the case; the circumference of which wheel rolls over the valves as they are forced beneath it by the steam, and press them successively against the cylinder. This wheel and spring piece constitutes the third and last particular claim of the patentee in this engine.

There being no mode described of making the parts of this engine steam tight by packing, they must be all made so by accurate workmanship and grinding, the expence of which in the onset, and in the repairs, would certainly be too considerable to allow it to come into competition with other steam-engines of a more common and practicable construction.

This engine is similar in its principles to one contrived by Mr. Cook, more than 30 years ago, which is described in the third volume of our work, first series, and which we could never learn was ever carried into effect, though much less complicated, and affording more facilities of construction than that which is the object of the present specification.

Patent granted to JOSEPH ASPDIN, *of Leeds, Bricklayer, for an improvement in the mode of producing artificial stone.* Dated October 21, 1824.

THE patentee states that this artificial stone is a cement, to be called Portland cement, which is to be employed for stuccoing houses and water cisterns, and for other uses. To form it, he directs that "*puddle*" or powder from roads laid with limestone, or the limestone itself used for that purpose (when the other material cannot be procured in sufficient quantities), should be calcined, and when slaked should be mixed with a "*specific*" quantity of clay and water to an "*impalpable*" state, by manual labour or by machinery, and should then be put in a "slip pan," and be dried by the sun, or by fire flues beneath the pan, until entirely deprived of the water. The whole is then to be broken into lumps, and again calcined in a lime kiln, after which it is to be reduced to powder by grinding, rolling, or pounding, when it will be fit for use.

The above are the whole of the directions given for preparing this cement, in which it will be observed that neither the proportions of the clay to the lime, nor its previous preparation, are stated.

The general outline of the method, however, is the same as that published by M. Vicat many years ago, and we understand practised in this country as well as in France since 1820. M. Vicat directs that from 0·15 to 0·40 of

the clay should be used with the lime, according as the limestone is more or less rich, or contains less of extraneous substances, 0·20 being a good proportion in general, and that the clay should be freed by any of the usual methods from any gravel which it might contain.

Relative to the use of road materials from roads made of limestone, to which the patentee seems to have a singular predilection, we have made some observations in treating of another of his patents, in our third number of this series; and shall close our remarks on this patent by expressing strong doubts whether a specification, which describes a cement or stucco only, can satisfy the proviso of a patent granted for *making artificial stone*, so as to make it valid, even if the circumstances beforementioned did not so powerfully operate to its prejudice.

Patent granted to John Head, *of Banbury, Oxfordshire, Hosier, for improvements in machinery for making cord or plat for boot and stay laces, and for other uses.* Dated November 4, 1824.

The machine for which this patent was granted is described as applied to platting twelve threads into one hollow cord, in the centre of which a solid cord of any kind, of a fit size, may be inclosed or not, as thought proper; but it is evident other machines, on the same principle, may be made so as to plat a greater or less number of threads in the same manner, provided they are in even numbers, as stated by the patentee. The engine for platting twelve threads has six axles, placed vertically, at the same distance from a common centre, and each axle carries a horizontal spur wheel, the teeth of which work in those adjoining, so that the whole six are put in motion by moving any one of them; but of course from the action of their teeth they revolve alternately in opposite directions, which is necessary for the proper movement of the bobbins. These axles are placed in a plane frame, formed of two hexagonal rails, connected by a due number of uprights.

Above the upper one of these rails are fixed two horizontal metal plates, with a small interval between them, through both of which the six axles pass upwards a short space. The lowest of these plates is left unaltered; but in the upper one is cut out six circular cavities, one round each spindle, in such a manner that their circumferences intersect each other so as to leave open spaces between each pair, for the passage of the bottoms of the bobbin holders from one circle to the other. These bottoms are of an oval shape, of about half the radius of the open circle in breadth, and on each spindle is fixed a circular button or knob between the plates, of nearly half the diameter of the open circle, which button confines the oval bottom of the bobbin holder to move in the track between it and the edge of the circle; and to secure the oval bottom from rising up from this track, a small oval plate is fastened below it, the edges of which project a sufficient distance to come under the cut plate. Two bottoms of bobbin holders are placed in each of these circular tracks, but at opposite sides; and to put them in motion, four arms are fastened to the top of each of the six vertical axles, one pair of which are placed over the other pair, and so as to form a cross, and their length being such as to pass a small distance over the adjoining circular tracks, they would impede each other's motion were it not for the precaution taken, just mentioned, of placing every second pair in a different plane, which causes the ends of the upper pairs to pass close over the others without touching.

The consequence of this described arrangement will be, that, when the axles are put in motion, the bobbins will be driven by the revolving arms from one circle into the next; but, on account of the spindles and their arms moving alternately in opposite directions, they will pass alternately from the external part of one circular track to the internal part of the next, and from that to the external side of the ensuing circle, so as to pursue altogether a serpentine course round the frame; six of the bobbins

following one another in the same track, while the remaining six are made to move in the opposite direction, crossing the tracks of the others in passing from one circle to the next, so as to interweave the threads that proceed from them all to the common centre, where they meet to form the cord.

The bottom of the bobbin holder described performs an office so essential to the operation, that it may in fact be considered as a distinct part, to which the bobbin itself is secondary.

From this bottom part a stem rises up, which has two small plates proceeding at right angles from it, between which the bobbin is placed in a vertical position, in which it is retained by a pin or spindle that passes through its centre, and through the upper plate, and turns in a cavity in the lower plate. The bobbin itself is of the common form, made of metal, with a hollow body, and about four inches in length. To prevent the thread from coming too quickly from it, the following method is adopted: the surface of its upper disk is indented with notches, into which a catch falls from the upper plate of the holder, where it is jointed, and has another arm so placed, that when it is raised up the catch rises with it, and permits the bottom to turn round which it before prevented from moving; two wires being fixed parallel to the back of the stem, and between the three a small weight being placed so as to be moved up and down, the thread from the bobbin first passes through a hole in the stem, then ascends through a hole in the upper plate, and passes downwards again through another hole in the same plate; then passes through a wire loop in the small moveable weight, from which it again ascends through a third hole in the upper plate, and from thence goes upwards, to join the other threads in the common centre, where they form the cord. By this arrangement, as the thread is woven up, the little weight will be made to rise till it comes in contact with the longer arm of the catch, by which it

will raise the latter, set the bobbin free, and then fall down again instantly, drawing from the bobbin at the same time a fresh supply of thread, for continuing the work as before. The catch is then again pressed against the top of the bobbin by its little spring, and prevents its turning till the weight again rises to raise its arm. The centre, where all the threads meet, is placed at some inches' height above the machine, where the cord, as it is formed, passes through a hole in a small plate, and over a pulley, from whence it proceeds sideways, in a horizontal direction, to two revolving rollers, which draw it off and deliver it from between them into a basket, placed beneath for its reception. The rollers are turned by an upright axle, placed at one side of the machine, the top of which carries a screw that works in a toothed wheel on one of the rollers; and on its lower part is fixed a toothed wheel, which acts on one of the six toothed wheels of the machine before described, and thus gives motion to the whole; the power which is used for this purpose being first applied to this axle, as the part most proper for its communication.

This is an ingenious little machine; but on account of the draft of the thread from the top of each of the bobbin holders pressing it towards the centre, a binding will be caused on the bottom part, which will make them move stiffly and unevenly. This might be much remedied by causing the thread to pass ultimately from near the bottom of the bobbin holder to the central pulley, instead of from its top.

Mr. Heathcoat, of Tiverton, obtained a patent for a machine for the same purpose as this invention of Mr. Head's, in November, 1823, which, though much more complicated, has its bobbin holders contrived so as to move with much less friction, and a great deal more evenly and steadily.

Patent granted to James Gunn, *of Hart-street, Grosvenor-square, Coachmaker, for certain improvements in wheeled carriages.* Dated October 14, 1824.

The first thing described in the specification of this patent is a method of constructing the lower part of the bodies of stage coaches, which may be understood by supposing a stage coach of the kind most in use at present (with the fore and hind boot attached to the body) which, instead of having the pannels of the body to come down close to the bottom, had them short of that by 12 or 14 inches, so that its general appearance would be that of a very low body, having beneath it a case, seeming to be a continuation of the hind boot, and of the same construction and colour; but this lower part, instead of being what it seems, is in reality the lower part of the body, the seats being on a level with the bottom of the pannels, and this apparent case constituting the receptacle for the feet of the inside passengers, and the space beneath the seats. The door of this coach not coming down lower than the bottom of the pannels, its place is supplied in the lower part by the step of the carriage, which is made large enough to supply its place there, when turned up, being fitted properly into the lower part of the door frame for that purpose, and thus performing the double offices of step and door, so far as it extended upwards. To secure this same part further, the patentee directs that an iron frame, with grooves, may be fixed round it, into which an iron plate is to be fitted, so as to slide in tight, which, in case of the coach having to pass through water, is to be pushed down into the grooves, which, according to the specification, will prevent the entrance of the water into the body of the coach.

Next after this follows the account of the fore boot, of which the lower part is to turn horizontally along with the fore wheels; the futchels, and other parts necessary for forming the connexion with the axle and the pole, being attached to its bottom. To form the revolving joint of this part, a grooved ring of iron is fixed to it, of the

diameter of its breadth, in the groove of which a projection in a similar ring, attached to the upper part that is united to the body, enters; and bars being fixed across the diameters of each of these rings, from the centre of the upper one a pin or bolt descends, that enters into a socket in the lower one, which being fastened below by a cross key, prevents them from separating. These rings may also be formed so as to act without the bolt or cross bars, by the projecting ring being made wider at its lower part, and the groove in the lower ring formed to fit it. The rings may likewise be made flat (without grooves or projections), and be kept in contact by four or more horizontal rollers, fixed to the upper part of the boot, close round the moveable ring, at equal distances from each other, the rings in this case having cross bars and a central bolt, as in the first plan. A variation may besides be made in the positions of the rings; that which was directed to be attached to the upper part of the boot being fixed to a lower moveable portion, and the other on the contrary occupying the former place of this one.

The lower revolving part of this boot is to be fitted up to form a safe receptacle for valuable property; its sides, inside the wood work, are to have circular plates of iron all round them in every direction, fastened by their centres alone; so that if an attempt be made to cut into the sides of the boot by the large centre bits, which thieves use, the farther progress of the bits, when they come in contact with the circular plates, will be rendered impossible, by the plates turning round their centres as the bit revolves. The passage into this receptacle may be either through the upper part of the boot, or through the back part of the receptacle, which latter appears to be preferred, from its position requiring it to be turned round so that the pole, which moves along with it, shall be nearly at right angles to the body of the coach before it can be opened, by which the difficulty to thieves of getting at it when it is on a journey will be greatly increased. The door of this

receptacle is to be fastened by bolts, having locks close beside them, so placed that, when the bolts are pushed in, on the lock being turned its tongue or bolt enters into a cavity in the bolt next it, and prevents it from being again drawn back.

To convey bank notes or money, divisions are formed in this receptacle in the revolving part of the fore boot, into which iron boxes for holding them being thrust from behind, are prevented from being drawn out, by chains placed diagonally across the entrances to the divisions, and fastened by padlocks, over which the door of the receptacle is closed by the means just mentioned. And to still farther secure this receptacle, an alarm is so connected with its door that, on this being opened, a ring slips off a pin that confined it, and lets go the alarm.

A considerable space is occupied in the description of this alarm and its varieties; but a general notion of it may be formed by conceiving an axle with a small wheel on it, from the rim of which several catches project, that act against either spring plates or the shanks of hammers; and that this axle is so connected with a spiral spring, that on its being wound up, and the ring placed on the pin before mentioned, as soon as the ring is forced off the pin again, the spring turns round quickly, and causing the axle to revolve along with it, by means of the catches forces the plates or hammers to rise, which in their fall causes a noise that cannot fail to attract the attention of all within a considerable distance.

The fellies or streaks of the wheels for this coach, or others, the patentee states, will be improved by having small plates fastened at each side over their points of connexion, and by having metal knobs fixed to their rims, so as to enter into corresponding cavities in the ring-tire which goes round the wheel. This latter part may be varied by having the knobs fastened to the ring-tire, and the cavities for them formed in the outside circumference of the fellies.

To the side plates, at the joinings of those fellies on the inside of the hind wheels, are to be fastened rings or hooks, for the purpose of holding a drag chain, or a piece of bolt iron serving for the same use, that is attached at the other end to the hind boot, at a sufficient distance from the axletree, and which, when hooked on to those plates, prevents the wheel from turning.

The patentee, after this, describes particular formations for the ends of the axles and boxes of the naves, the object of which is to secure the wheel better from separating from the axle accidentally. In the first of these methods a collar or ring is placed on the inner part or shoulder of the axle, and another collar screwed on outside it, to keep it from being drawn off, which screw-collar is to be farther fastened by side pins passing through it; and the inside part of the box of the nave being made sufficiently wide next the shoulder to contain these two collars, when put in its place is to have screws passed through this enlarged part into the loose inside collar, which then revolves along with it, and prevents the wheel from coming off by its action against the fixed collar. Another method described for the same purpose consists in having the outer extremity of the axle made hollow, to contain the cylindrical head of a bolt made so as to turn round freely within it; a round collar is then passed over the bolt, and having a screw cut round it, which fits in a corresponding hollow screw at the end of the cavity in the axle, is screwed into it so as to keep the head of the bolt securely within it. This bolt passes through a hole made for it in a plate, that is fastened on the face of the nave, outside which a nut screws on it, over a washer, and a pin passed through the nut afterwards keeps it from turning so as to come off again from the bolt. It is obvious that it is the head of this bolt that will then chiefly keep the wheel from coming off, and that the advantage of the contrivance will lie in tending to prevent the nut and screwed collar from being turned off, by the bolt itself moving round with the

wheel. The patentee further directs the use of axles hollowed through their whole extent, as being stronger than solid axles of an equal weight, and points out a method of converting part of this hollow into a vessel for holding oil, for lubricating the part of the axle that enters into the nave.

The following method of arranging the springs that support the coach is also described in this specification. These springs are to be of the straight flat kind now commonly used for stage coaches, and to be placed like them, underneath between the body or boots and the axles, but differ from them in arrangement, three of them being placed at each point of support, so that twelve, altogether, will be used for the coach. Of those three one is attached by its middle to the axle in the usual place, and to each end of this one the middle of one of the others is jointed beneath; the farther ends of these two secondary springs are then jointed in the usual manner to the bottom of the body or boots, and their ends next the axle are joined by links, either to the axle itself, or to the primary spring near to the axle, this latter point not being explained in the specification.

There is no apparent advantage in the mode of forming the under part of the body of the coach as directed in this specification. Part of the door being composed of the step, would, in our opinion, be awkward and inconvenient; and the sliding metal plates for keeping out water would, we apprehend, be quite ineffectual for that purpose, it not being possible to make a water-tight joint for them according to the directions given in the specification for their construction.

The construction of the fore boot seems well contrived for the security of property put into it, and the circular plates for preventing the action of centre bits likely to be serviceable on other occasions, particularly for the defence of doors and window shutters.

The method of strengthening the connexion of the fellies of wheels, by side plates at their joinings, has been before used, particularly for artillery wheels, from a very remote period.

The first plan for the construction of the boxes of the naves and the ends of the axles appears to us very similar to others which have been long since made public. The axletree and box, for which Mr. Rowntree took a patent in April, 1805, are evidently formed on similar principles, as are those likewise for which a patent was granted to Messrs. Barclay and Cuming, in May, 1814, although not so nearly the same as the former. The other plan for the same purpose appears somewhat new, although so many methods have been used for the same purpose that we should not wish to affirm very positively that it is so.

The hollow axles deserve a trial, although we should not like to trust to those made so at the shoulder; perhaps, if axles were made solid about this part, and hollow in the rest of their extent, they would be preferable.

Patent granted to John Lane Higgins, *of Oxford-street, Middlesex, Esq. for certain improvements in the construction of the masts, yards, sails, and rigging of ships, and smaller vessels, and in the tackle used for working, or navigating the same.* Dated 7th July, 1824.

The greatest part of the subjects of the specification of this patent, relate to the rigging of sloops.

In the first method directed for this purpose, the boom is prolonged forward before the mast as far as the head of the vessel, and a stay connects this end of it with the top-mast; the gaff also is extended forwards, and being at the same time bent downwards in a curve, joins the stay mentioned, about a third of the distance from the top to its lowest extremity, when the former is at its greatest elevation; but as it is necessary that this gaff should be lowered, when the sail is required to be reefed in the way directed by the patentee, its lower end traverses up and

down on the stay by a roller, which confines it to the stay without impeding its descent or ascent. A single sail occupies the whole of the space between this gaff, and stay, and the boom; it is laced to the gaff in the usual way, and is joined to the stay by rings called "cringles," and in this way it serves the purposes both of mainsail and foresail; the reefing laces are at the bottom of the sail, but are not arranged parallel to the boom, but to a line drawn from its aft end to the lower extremity of the gaff; and as this latter is lowered are taken up below, and the gaff being brought more forward by its connexion with the stay, as its fore end is brought down, its upper end still maintains nearly the original elevation, and only approaches nearer to the mast, which accounts for the disposition of the reefing laces just mentioned.

The patentee also proposes, in place of the single mast usual for sloops, to erect two in the same line across the vessel, each being about an eighth of the breadth of the vessel from the centre, as far as can be judged from the drawing; these two masts ascend parallel to each other, but are joined at top either by a cross piece strengthened by iron diagonals, or by two curved pieces scarfed to their extremities, which make their connexion assume the figure of a gothic arch; a topmast is attached to them in this part, and they are all three connected to the sides of the vessel by shrouds and stays in the usual manner. The long boom lying then between the two masts, the sail will not be impeded by them more on one tack than on the other, as would be the case with a single mast.

For large ships a bowsprit is to be used, but for small vessels this may be dispensed with, and instead of it a spar fastened to the fore end of the boom be employed, of sufficient strength to carry the jib-sail. In this mode of arranging the sails, particularly in that last mentioned, on each tack the fore end of the sails will traverse over to the windward side of the vessel, from which the patentee ex-

pects great advantages; one of which is obvious in its causing the weight of the fore end of the boom and of the spar to pass to that side of the vessel, and so far counterbalance the pressure of the wind in inclining the sails to the leeward, but of the other advantages seamen alone can judge.

Where a bowsprit is used, the patentee directs that the jib-boom be fastened at near its middle to the end of the bowsprit, so that its aft end can traverse across the forecastle by a ring and curved spar, or iron bar, prepared for it, (in the way usual for the moveable angle of the fore-sail in some sloops,) and that its fore end be turned to windward as required: he also mentions that the boom may be made double, of two pieces a little curved, and hooped together at their extremities, so that when a single mast is used, it will be in the middle between the two pieces. In one of the figures in which the boom and bowsprit are joined in one piece, the gaff is represented passing down in a curve entirely to the fore end of the united piece, like the bowed yards or gaffs, used for tartan-rigged vessels in the Mediterranean.

The patentee directs a new method for rigging a gaff topsail; instead of its being laced to the topmast in the common method, it is to be fastened at that side to a yard, placed parallel to the top-mast, and attached to it by its middle: the point of this triangular sail is to be fastened to the aft end of the gaff as usual, and a brace, or rope, passing from each end of the yard to the deck, either end of it may be brought down as required, according to the tack in which the vessel is steering. By this plan the gaff sail may be put up without sending any man aloft, pullies being previously placed at the proper situations on the top-mast, and on the end of the gaff, with ropes reeved through them, ready for taking up the yard and sail, when it is wanted.

For ships and other large vessels, the patentee directs a method for rigging the jib-sail somewhat different from

that before-mentioned, which is by having a boom or yard attached to the bottom of this sail, instead of the jib-boom, which is to be fastened to the end of the bowsprit, so that two-fifths of it may project beyond the bowsprit, and the other three-fifths run aft above it; two ropes being fastened to the aft end of this boom, and one of them being brought over either side of the bow, will serve to turn the fore end of the boom and jib to the windward, as required, in a manner similar to that described relative to the former jib.

A method is also directed for bringing the tacks of the fore and main-sails, in two masted vessels or ships, to a wheel on deck, by which the patentee states they can be managed with much more facility.

Of the plans of the patentee, that in which the boom is extended forwards, and placed between two masts, seems the most likely to be beneficial; as the sails used with it will have all the advantages of lug-sails, which are much estemed for quick sailing by seamen, without requiring to be shifted as these do, to have their full power on the different tacks.

The two masts might also be placed like a pair of shears, for the same purpose, and if fixed over a beam, and fastened to its extremities, and to the sides of the vessel by substantial and well managed iron work, would give so much support in the direction of the shrouds, that probably some of them might be dispensed with, which in addition to what would be saved in the shears costing so much less than the mast, would occasion considerable economy in the rigging. The shears combined in this way with the beam, would form a triangular frame, which is well known to be the strongest, and any additional weight thrown by them on the end of the beam might easily be supported by stanchions properly disposed.

Patent granted to HERMAN SCHRODER, *of Hackney, Middlesex, Broker, for a new filter.* Dated August 11, 1824.

THIS filter consists of a wide bag pleated in longitudinal folds, and inclosed within a case of metal, wood, ticken, or other materials, a little longer than itself, to prevent its being torn by protruding beyond its limits. The ticken case is preferred on account of its cheapness; calico is mentioned as a proper material for the filtering bag, though other substances would also serve for the same purpose; and its dimensions are particularised in one instance as being six feet round and two feet deep, but are not confined on all occasions to these limits; the case is to be made much narrower, probably less than a third of the width of the bag, that it may confine it, so as that it may always lie in longitudinal folds. A conical metallic funnel, with a screw at its smaller end, connects the bag and case with a vat placed above them; into the bottom of which the small end of the funnel is screwed up: and the filtering bag and its ticken case are fastened to this funnel by a ring somewhat narrower than its wider part, which is first passed over its neck; and the case and bag, being then drawn up between the ring and the funnel, are turned over the former, and fastened beneath it in any manner convenient. This mode of connecting the bag with the funnel will cause it to be pressed tighter to the latter, in proportion as the weight of liquor within it is greater.

Several of these filters may be fastened, in the manner described, below the bottom of the same vat, care being taken to leave sufficient space between them, that they may not touch one another when filled with liquor.

A clause in the specification, relative to the varieties of materials and dimensions of the bag and case, directs the latter to be always about the proportions stated, and among the materials for the case mentions netting. It also states that two or more bags may in some cases be

used one inside the other, to give more strength, prevent the ill effects of accidental holes, and to render the filtration more perfect.

It would seem, from the directions given relative to this filter, that the patentee had some particular application of it in view; but as he has not explained himself on this point, it can only be the subject of conjecture.

Among the materials mentioned for the cases, netting seems to have advantages not noticed by the patentee, as it would not be liable to interrupt the passage of the liquor through the filtering bags, which the other sorts of cases mentioned would do, more or less, as the outsides of the bags would be much pressed against them by the weight of internal liquor, and its passage between them and the cases obstructed proportionally.

Patent granted to Philip Weise, *of Tooley-street, Southwark, Surrey, Manufacturer, for certain improvements in preparing and making waterproof cloth, and other material for manufacturing hats, bonnets, caps, and wearing apparel.* Dated October 14, 1824.

The materials of which the articles recited in the title of this patent are to be made are very miscellaneous; among them are enumerated beavers' fur, the sort called neuter, musk wool, the fur of hares' backs, Saxon wool, lambs' wool, flax or hemp, carded silk, and down or feathers. The proportions of these are to be 5 lb. of the finer furs, $2\frac{1}{2}$ lbs. of the wool, 2 lbs. of the flax, 1 lb. of the carded silk, and $\frac{3}{4}$ of a pound of the down or feathers, as nearly as we can recollect. These materials are to be divided into portions of about two ounces each, and to be passed through a fine carding engine by one portion at a time, the fine fur being first laid or bowed on the roller cloth of the engine, which will cause it to lie on the outside of the

carded flake. After being thus carded, the materials are to be drawn, roved, and spun, like cotton, the management directed for them being the same as is used for that substance.

The yarn spun is to be of two sorts, one fine, for the warp, and the other coarser and softer, for the weft. It is then to be woven in a loom of from 8 to 12 "lambs," and a proportional number of threadles. The fine yarn forming the warp is to be kept at the back of the cloth, and the soft weft in the front, by the means well known to weavers, and similar to those used in weaving diapers and velvets.

When the cloth is wanted to be made waterproof, a composition is to be prepared of equal portions of shell lac, caoutchouc or elastic rubber, mastic, gum animi, and sandarac; by cutting the caoutchouc into very small shreds, and pounding the gums and lac very fine, and then dissolving them in "spirits of wine," or spirits of turpentine. Into this composition the fine skeins for the warp are to be dipped, and then to be gently pressed or left to drain, and to be hung up to dry; and when dry, are to be stretched in the loom, where, instead of the common sizeing, the composition above stated is to be used.

After the cloth is woven, the fur or nap is to be drawn forward on its front by teazles or cards, and a hot smoothing iron is to be passed over its back, to cause the composition to sink into it, and close the interstices.

This cloth, when intended for hats, is to be laid over linings or moulds, on hat blocks, of the same materials usual for those of silk hats, and to be managed in the same manner.

For wearing apparel the cloth is to be chiefly made of Saxon wool and flax, managed as before-mentioned; and when cloth with a pile, like plush or velvet, is wanted, it is to be woven in a velveteen loom, and then to be cut in the usual manner.

The directions in this specification should be taken with a little allowance, for if followed literally, for example, with regard to the carding, the destruction of the cards must be the consequence, as no cards fit for fur or wool could be strong enough to card flax or hemp, directed to be mixed with those materials.

In the composition for making the cloth waterproof, it should also be noted, that spirit of wine has no power to dissolve caoutchouc, as inferred by the patentee.

We shall just mention here that the parts of a loom commonly called lambs, as above, ought probably to be written lames, as being derived from the French language originally, in which that word signifies a blade, and from thence a thin flat piece of wood.

Patent granted to THOMAS HODGSON, *of William-street, Lambeth, Surrey, "Veterenarian," for improvements in the construction and manufacture of shoes, or substitutes for shoes, for horses and other cattle, and for methods for applying the same to the feet.* Dated October 7, 1824.

THE patentee commences his specification with laying down the proportions of the height of a horse's hoof to its breadth and length, stating also that the angle of inclination of its sloped part in front, and at the heel, is 30 degrees with the perpendicular. He also mentions that the hoofs of asses, and of other beasts, have the same angle of inclination likewise.

He then describes the shoe to which his patent relates as being made of an oval form, but larger in front, so as to fit the "*bulges*" of the hoof, while the narrow part of the oval (according to the sketch which is given of it), comes round the extremity of the frog. But it appears afterwards that the shoe is not to be left oval when finished, as it is directed to be cut open at the heel, and to be turned downward and outward at the hinder part, so as not to come in contact there with the hoof (as appears from an-

other sketch), for about a third of its length. Its breadth and thickness are represented about the same as those of a common horse-shoe.

The bottom of the shoe is to be channelled, and cut rough like a rasp, to keep the horse from slipping; and to prevent this roughness wearing away too fast, the shoe is to be made somewhat concave, so as to press on the ground at the outside edge principally; and the hoof is to be pared a little concave at the back, to keep it from touching the shoe in that part till pressed down by the weight of the animal. The shoe will therefore only come in contact with the hoof in the front for about two-thirds of its length, and there it is to be fastened to it firmly by nails in the usual manner.

The patentee mentions that he is aware that shoes have been made somewhat of this shape before; but that this not having been done with reference to the proportions of the hoof, which he has laid down, he claims the method of doing so as his invention. He also states, that the same method of making shoes is applicable to those for other animals as well as for the horse.

The patentee not having given any explanation of the connexion between the proportions which he has so precisely laid down for the hoof of a horse, and the mode of forming the shoe with reference to it, we are entirely at a loss to conceive on what he founds his patent right. Having, from circumstances, uninteresting to explain, seen frequently great numbers of hoofs in a prussian blue factory, we can answer for it that the variety of shape and form of hoofs is as great as can be conceived, consistent with the general character of the animal to which they belonged; and that any thing like mathematical precision on the subject is the last point we should have expected to see urged respecting them.

The appellation which the patentee has subjoined to his name, "*Veterenarian*," not being of regular authority as an English word, and its Latin original, *Veterenarius*, not being used by any classical author of note, has not been judicious; more particularly as the vanity of our gallic neighbours has caused their common blacksmiths to assume the title of *Artiste Veterenaire*, of which we can point out a conspicuous instance adjoining the Eglise de St. Sulpice, at the end of the Rue Ferou, Paris, where these words, in large letters, designate the forge of an ordinary horse-shoeing Vulcan.

If the idea we have formed of the meaning of the patentee be at all correct, the practice he recommends is admirably adapted to produce patients, that is, lame horses, for the exercise of the "Veterenarian's" skill in their cure, at least so far as the horses of Europe are concerned; and with those only are we intimately acquainted, though we have reason to believe that the horses of Asia may be somewhat different; that is, from having feet that are small, with the insensible covering very thick, very tough, and proportionally inelastic, they may be misused to a greater extent, without mischief being produced, than the general run of horses' feet in this country will bear. We know this to be the case with the Asiatic description of feet in this country, where, however, from the fancies of breeders, the mixtures of breeds, and various other causes, the varieties in feet are almost infinite.

Many years ago we saw the horses then at Astley's Amphitheatre, the ground surfaces of whose shoes were channelled, and cut rough like a rasp, to keep them from slipping. This, therefore, is not new; neither is the mode of making the shoe somewhat concave, so as to press on the ground at the outside edge principally (that is, if the surface of the ground was plane, and so hard as to be impenetrable). Nor is the mode recommended of having

the shoe in contact with two-thirds of the hoof only, and that at the fore part, at all novel; it is the every-day practice of farriers, as one of the means adopted to make a lame horse useable, upon the simple and obvious principle of diminishing the pressure on a tender part, and increasing it on a healthy part. But this mode is not a prophilactic; although it will palliate the pain resulting from disease, it will not prevent disease taking place. Indeed, from giving the foot an unnatural bearing, from twisting and distorting it, a much more likely consequence is, the production of disease.

Patent granted to PHILIP TAYLOR, *of the City Road, Middlesex, Engineer, for improvements in steam-engines.* Dated July 3, 1824.

THE objects which this patent is intended to secure, are an arrangement of the piston rods of cylinders of steam-engines, when in an horizontal or inclined position, to prevent the pistons from pressing unequally on the cylinders, and a method of combining two or more cylinders so as to direct their joint powers to one operation.

The patentee directs, for attaining the first object, that the piston rod shall pass through the piston, and out through the opposite end of the horizontal or inclined cylinder, being provided with fit stuffing boxes at both of its extremities, and that each end of this long piston rod shall be furnished with a vertical wheel, grooved at its rim, and moving between two metal guides, parallel to each other, and to the sides of the cylinder. These guides being of course one above and the other below the wheels, would prevent the weight of the piston from making it press too much at the lower side of the cylinder, if the rod were perfectly inflexible; but as this cannot be, the patentee supposes that he will effect his purpose by causing considerable weights to act on each end of the rod in opposite directions, by appending them to the

horizontal arms of "bell cranks" or bent levers, so as to tend to keep the rods straight by their being in a state of tension. These weights may either consist of pump rods at each extremity when the engine is employed in pumping the water from deep mines, or a pump rod may be at one extremity and the weight at the other, in which latter case the power of the engine exerted in lifting the weight would not be lost, as the weight would react on the piston rod in its descent, and assist the engine in lifting the pump rod and water at its opposite extremity.

It is obvious that these engines may be employed in producing rotary movements for mill work, as well as those of a reciprocating nature mentioned; but with the rotary movement the tension of the piston rod would not be effected, without weights being appended for this purpose to the bent levers at each of its extremities.

The action of two cylinders managed in this manner may be combined by placing them parallel to each other, and uniting their piston rods at each end to strong cross pieces, from the middle of which rods are to proceed to the bent levers, weighted as before. In the drawing two cylinders are represented, lying on the same horizontal plane, and having the wheels and guides at each end of the cross pieces, instead of being in the same line with the piston rod; but it is evident they may be placed one over the other also on the same principle, and that any number of them may be combined in this manner by properly disposing the cross pieces and wheels, which latter, however, need not be multiplied as the number of cylinders are increased, as the same number of wheels that will serve for the piston rods of two cylinders may also be made to support those of several more.

A method of binding these cylinders down firmly to their supports, whether the latter are constructed of stone or of cast-iron, is described by the patentee; as is also the mode of disposing the tubes that convey the steam to the several cylinders, and from them to the condenser, or

to the open air (according to the nature of the engines), so as to make one set of valves or slides serve for them all. But as there is nothing particular in the arrangement of these tubes, or in the method of fastening down the cylinders, being such as may be easily conceived, they do not require further explanation.

We have made a few remarks relative to steam-engines with horizontal or inclined cylinders, in our account of the Operative Mechanic, by Mr. J. Nicholson, in p. 363 of this volume; and we are sorry to find that the great defect of engines of this description still remains without an effectual remedy, the plans of the patentee serving only for its diminution, but by no means for its total removal.

The support given by the wheels at each end of the prolonged piston rod evidently cannot prevent the weight of the piston from pressing on the lower side of the cylinder with a piston rod of the usual thickness; and if the piston rod be increased in size sufficiently to prevent its being bent by the weight of the piston, the power of the engine will be very much diminished by the great space which this bulky rod (or more properly mast) would occupy in the cylinder. Neither can the method of remedying the flexibility of this rod, by the tension given to it by great weights acting on bent levers at each of its extremities, be more effectual than the other, from the well-known vast power which a weight has when appended to the middle of any line, chain, or bar, in a horizontal position, to press it downwards a certain degree, as explained in most elementary treatises on dynamics of any eminence: and although the weights appended to the bent lever will react as mentioned, yet that will not prevent the loss of power which they will cause to the engine, in putting them in motion from a state of rest each time they are elevated, and that this loss will be large may be understood from considering how great these weights must be to give any effectual tension to the piston rod.

We shall farther observe of the first method, that if the pressure of the piston is attempted to be remedied by causing the wheels at the extremities of the rods to be pressed downwards by the upper guides, the same objections will exist as in the case first considered, with the addition that in this latter plan the great additional pressure which it will occasion on the lower sides of the stuffing boxes must tend to cut them open in that direction, as well as to wear out the lower sides of the piston rods.

We are not aware of any advantage that can arise from the other plan of the patentee, of combining several cylinders for one operation, at least in this country, where cylinders may be procured of any size. On the contrary, we think it would occasion loss of power, and great additional expense, as it is well known that the friction in cylinders is directly as their circumferences, while their powers are as the squares of their diameters, from which it must follow that the friction in four cylinders, for example, each of a foot diameter, would be twice as great as in one of two feet diameter, whose power would be equal to the whole of theirs, to say nothing of the greater friction which four piston rods must cause than one; and, moreover, not taking into account the loss of power that must arise from the greater space which the four piston rods will occupy in their respective cylinders, which even in low pressure engines cannot be less than in the proportion of ten pounds to the round inch of their transverse sections, and vastly more in high pressure engines.

Patent granted to Charles Phillips, *of Frindsbury, Kent, Esq. for improvements on tillers, and steering wheels of vessels of various denominations.* Dated July 13, 1824.

Two methods are described in the specification of this patent of communicating the action of the steering wheel to the rudder, and also a method of keeping the rudder steady and fixed in the position required, which is employed in conjunction with both the other plans.

In the first method of using the steering wheel, its roller, on which the cord is wound that gives motion to the tiller, turns round on an axis to which the steering wheel is attached; and to the further end of this roller a grooved wheel is fastened, in which a chain is fixed that acts on the tiller in all ordinary cases. On the end of the roller where it passes through this wheel, two pinions are placed at opposite sides of its diameter, which are attached to it by bolts that form axles, on which they turn, and which bolts also pass through a flat ring, placed at the other side of the pinions, opposite to the roller. On the axle that runs through the roller a third pinion is fixed, between the other two, whose teeth interlock with theirs, each of the three pinions being about a third of the diameter of the roller; and a ring, toothed at its internal surface, surrounds the three pinions, in which the two pinions attached to the roller work, and which, being screwed or bolted to the post or frame which supports the end of the axle of the roller, the consequence must be, that when the axle is turned round by the steering wheel, the pinion on its end will turn the two pinions fixed to the roller, which, pressing on the fixed toothed ring at their sides, will cause the roller to move round along with them with a force equal to the multiples of the circumference of the central pinion contained in that of the toothed ring, plus one circumference of the pinion, which latter addition this disposition of the pinions and ring occasions.

From the grooved wheel on the roller before-mentioned, the chain passes through blocks and over rollers, properly arranged for the purpose, to the end of a short tiller on the rudder (when the chain is used by itself); but when a rope is also attached to the roller for occasional use, then the chain is fastened on the tiller (which is of the usual length), nearer to the rudder than that part of it to which the rope is to be attached.

To prevent the chain from getting slack in certain positions of the rudder, the patentee directs the grooved

wheel which works it to be made "eccentric," by which, and a proper position of its longer diameter, it will keep the chain equally tight at all times.

In the other method of moving the rudder, directed in the specification, a common steering wheel is used, from which the rope passes through blocks and over rollers, that direct its inflections to a horizontal wheel, placed with its centre directly over the gudgeons of the rudder, above the tiller, which in this case is made of iron, and is fixed to the top of an iron support that rises up from the *back* of the rudder, to which it is attached by being bent round at its lower end, and passing through to the front of the rudder head at that place.

From a point of the tiller, thus arranged, nearly over the centre of the rudder, a bar rises and bends off forwards at right angles, till it comes over the gudgeons of the rudder, and then rises up vertically again, where it forms the axle on which the horizontal wheel before-mentioned turns. There is reason to think, likewise, that the patentee intended that the lower end of this crank-shaped bar should turn also in the part of the tiller from whence it ascends. The front of the horizontal wheel projects beyond the tiller, and the end of this latter turns up at right angles, and enters into a cavity or groove cut for it through the wheel, of a particular shape, which may perhaps be conceived by supposing the groove to be parallel to the circumference for an eighth of its extent, at each side of the fore and aft diameter of the wheel; but when pretty near to this diameter, to incline inwards at each side, so as to meet at a point in the diameter nearer to the centre, in an angle of about 90°. The patentee asserts that this method of connecting the horizontal wheel with the tiller will add to it a great mechanical force.

The method of keeping the rudder steadily fixed when required, consists in having a horizontal wheel fixed at its top concentrically with its gudgeons, round the greatest portion of the outward edge of which wheel a band of iron

passes, which is sustained in its place by flanches projecting from the wheel. One end of this iron band is fixed to the timber of the stern, and the other end to a lever near its centre of motion, which centre is a joint also fixed to the stern timbers: from the other end of this lever a rope is passed upwards, over pullies properly placed, to a ring close to the steering wheel; by pulling this rope the steersman can, from the action of the lever, cause the iron band to press on the edge of the wheel with great force.

In the second method described for giving motion to the rudder, this friction wheel is united to the horizontal wheel, which in it is fixed above the tiller, and forms with it one piece of the same circumference.

In the first described apparatus for moving the rudder, the small size of the pinions at the end of the roller of the steering wheel, as represented in the drawing, seems very ill calculated to give them the strength necessary for an operation, on which the safety of the ship so much depends. The method directed, of fastening them to the roller, is also very weak and imperfect.

The second plan described for the same purpose exhibits a curious instance of error. Because the bent end of the tiller will take some more time to be acted on by the wheel at each turn, on account of its having to traverse along a portion of the groove previously, from some confusion of ideas relative to the maxim in mechanics, that power gained is directly as the time expended, the patentee fancies that because the groove causes a *loss* of time it must gain power; when, in reality, the power of the wheel connected in this method by intermediate parts with the tiller, is in no respect greater than if it were actually fixed to it or to the rudder.

In the machinery which we have seen in some vessels for this purpose, the apparatus was so contrived as to rise

along with the rudder, in case of its being lifted up in taking the ground, or in passing a bank, or by some sudden violent percussion from the waves in a storm, which preserved the machinery from injury at the time when it was most required. In the plans of the patentee there is no arrangement whatsoever for this object, and this omission alone would so far make them inferior to the methods already in practice.

Patents.

Persons desirous of obtaining Patents for inventions may have them procured with little trouble to themselves, and generally without their personal attendance in London, on application to the Proprietors of the Repertory, (addressed to Mr. Wyatt, Maiden Lane, Queen-street, Cheapside), who, from long practice and experience, presume they may be enabled to afford important assistance to Patentees in drawing up and adjusting their Specifications, on the accuracy and perspicuity of which, in a great measure, depends the security of the Patent.

	£.	s.	d.
The cost of a Patent for England, in the usual course, when unopposed, exclusive of the Specification, the expence of which depends upon its length, the trouble of preparing it, and the quantity of drawings, &c.	105	0	0
The cost of a Patent for Scotland.................	75	0	0
Do. Do. Ireland.....................	120	0	0

ERRATA.

Page 46, line 6, *for* raising great loads, frequently would, &c. *read*, raising great loads frequently, would, &c.

Page 56, lines 11 and 12 from the bottom, *for* will also have its limits, and the moving forward much quicker than the compressed air. Yet, &c. *read*, will also have its limits; and tho' moving forward much quicker than the compressed air, yet, &c.

Page 107, 12th line from top, *for* source of inaccuracy, *read*, mode of inaccuracy.

Page 130, 20th line, *after* even, *insert*, be led.

Page 134, 8th line, *for* impressed, *read*, compressed.

Page 241, 3d line, *for* M. Sequin, *read*, M. Seguin.

END OF VOLUME I.

A

COMPENDIUM

OF

THE LAW OF PATENTS.

CHAPTER I.

Of Patents in general.

ALL grants from the Crown are made, not by deed or indenture, but by certain instruments called *letters patent*, or open writings, to which the great seal is affixed. In ancient times, when the Crown held large tracts of forest land and the estates of religious houses dissolved by Acts of Parliament, and was also in the continual acquisition of forfeited estates, these grants were very numerous, and were made upon various occasions. In modern times, besides patents of nobility, grants of offices, and charters to companies, they are most commonly applied to one single purpose, that of securing to an individual a monopoly in some new manufacture, or invention as it is more commonly termed, for a limited period, not exceeding fourteen years.

The first object of these patents is, in a general sense, universally understood; but there are some

distinctions in the law concerning them, with which few persons are well acquainted; and the extreme caution which is necessary in the first procuring, or, as it is called, in soliciting them, is very little known, and therefore not always sufficiently observed. It has been said, indeed, by those best acquainted with the subject, that of the numerous patents obtained in the course of a year, not one-tenth could, if strictly examined, be sustained.

To persons wholly unacquainted with the subject, it might naturally appear, that the Royal authority having been once obtained for the monopoly of an invention, the proprietor must be thenceforth secured against all interruption in his enjoyment of it, during the term for which it is granted. There cannot, however, be a more erroneous opinion; for, in truth, the validity of a patent depends not upon the mere appendage of the *great seal*, or the authority of the Crown, of which it is the emblem, but on the nature of the manufacture itself, the conduct of the inventor or proprietor in obtaining the patent, and the correctness of the specification. Unless these be strict and regular in every part, the patent is of no avail, and the inventor has consumed his time, ingenuity, and labour, and wasted his money in vain. The author has upon many occasions found the parties for whom he has been employed to solicit patents, entirely unacquainted with the true extent of the authority or protection which they sought to obtain under the Royal grant, and completely uninformed of the

requisites by which it was to be secured. In some instances this ignorance has led to fatal errors being committed before the author was consulted, which could not afterwards be remedied. He has therefore attempted to collect, in the following concise treatise, such plain and easy instructions as appear to him almost incapable of misapprehension, in order that persons seeking letters patent may be put upon their guard; and by informing them of the points to which in strictness they ought to direct their attention, not only to facilitate the obtaining of their patents, but to render such patents secure and valuable when obtained. In doing this, it has been his aim to avoid the compiling of an elaborate treatise. For he is convinced that simple and plain instructions are alone wanted; that the parade of learning would, on such an occasion, be an ostentatious and useless display, and that the end to be desired is not to set every inventor upon the conceit that he is equal to the soliciting of his own patent, but, on the contrary, that he should be warned of the technical difficulties which may occur, and see the necessity of obtaining proper advice from persons of experienced practice; and, above all, should be assisted in preparing a proper specification, that he may not, instead of a protection to the privilege which he claims, be deluded with a mere form, leaving an opening for others to step in and take the profits which his ingenuity has created, and his labours have matured.

CHAPTER II.

On the policy of granting Patents, and of publishing the Specifications.

THE wisdom of granting patents has been doubted by several enlightened men, among whom may be ranked, as foremost, the two late Chief Justices of the Court of King's Bench, Lords Kenyon and Ellenborough. An opinion is entertained by some persons that all inventions would come to light sooner or later, if no such protecting grant were made to their original authors.

It may be said, in answer, would Mr. WATT ever have brought the steam engine to that degree of practical perfection which it has now attained?

Would other important inventions have been completed, when the first attempt to bring them into notice has, in many instances, required an enormous disbursement, which the hope of the reward of an exclusive privilege could alone have induced the parties to have incurred?

The propriety of publishing the specifications of patents has also been much doubted. Lord Ellenborough has called the Repertory of Arts "a mischievous work, because it conveys a knowledge of the English inventions abroad." But, previous to the publication of the Repertory of Arts, foreigners used to visit this country purposely to inspect the rolls of specifications, and to transmit home copies of such as

they deemed worthy of notice. The incorrectness, however, of the opinion that the publication of the specifications of patents is mischievous must be evident, when it is a well-known fact, capable of easy proof, that most of the important inventions now flourishing in the kingdom have originally taken their rise abroad, and thence been imported by industrious individuals, encouraged to such conduct by the admirable system of patents. This circumstance is alone, perhaps, an answer to those who have expressed an opinion against the propriety of such a mode of rewarding those who, by this means, add so much to the prosperity of our manufactures. Individuals may sometimes, it is admitted, be injured by the publication of their inventions, because hints taken from them may enable others to surpass and supersede the first contrivance; but this is a public good, and cannot be justifiably opposed by individual interests. It is, besides, a leading principle in the law of patents, and a condition in every patent, that the *specification* should give publicity to the inventor's secret.

Among the most prominent inventions and discoveries for which this country is indebted to foreigners, may be mentioned, the new system of bleaching and tanning; the machinery for making paper in large sheets; and the invention of manufacturing paper from straw; and, above all, the very ingenious and important machinery erected in the King's Dockyards at Portsmouth and Chatham, for making ships' blocks. It is also a fact, that foreigners, particularly

Americans, are arriving constantly with important inventions; and by a reference to the list of patents, published monthly in the Repertory of Arts, it may be seen that those now granted for inventions communicated by foreigners, are nearly as numerous as those for inventions of native growth. If it is improper to publish specifications, it must be equally bad policy for the Royal Society, and other eminent scientific institutions, to publish their proceedings, which are very often the foundation on which patent inventions have been subsequently created. But no person will surely be bold enough to support such an opinion in opposition to the universal practice of all the scientific societies of Europe, who publish their proceedings in order to accelerate the general diffusion of knowledge, to which valuable purpose the Repertory of Arts may be said, with safety, to add in no inconsiderable degree.

CHAPTER III.

On the form and course of granting Patents.

By statute 27 Henry VIII. chapter 9, in order to settle the fees of the King's offices upon the granting of patents, it is enacted, that every gift or grant of the King, signed with his sign manual, to be passed the great seal of England, Ireland, and the Duchy of Lancaster in the principality of Wales, shall be brought to the principal secretary, or one of the clerks

of the King's signet, to be passed. One of the clerks of the signet, to whom the same shall come, shall, by warrant of the same bill, within eight days after, unless the King's pleasure to the contrary is signified, make warrants to the Lord Keeper of the privy seal for the same; and one of the clerks of the privy seal, upon due examination by the Lord Keeper thereof, shall in eight days after, unless commanded to the contrary, make a warrant with the name of the clerk to the privy seal, to the Lord Chancellor, or Keeper of the great seal, &c. for the writing and sealing thereof with the great seal.

The proceedings are now usually in the following order.

First.—An affidavit is made by the inventor, declaring that he has invented or discovered something which he specifically describes, and that he is the first and true inventor thereof.

Secondly.—A petition, praying for letters patent to be granted for the said invention or discovery, is prepared.

Thirdly.—The petition is referred by the Secretary of State for the Home Department to the Attorney or Solicitor General.

Fourthly.—The Attorney or Solicitor General makes a report thereon.

Fifthly.—A warrant for the bill, signed by the Sovereign, is issued to the Attorney or Solicitor General.

Sixthly.—The Attorney or Solicitor General pre-

pares and signs a bill for the patent, which is also signed by the Sovereign.

Seventhly.—The bill, and transcript thereof, are transmitted to one of the clerks of the signet and Lord Privy Seal.

Eighthly.—The patent receives the great seal, and, in consequence of the proviso or condition contained therein,

Ninthly.—A description of the invention is enrolled in the Court of Chancery, which is called the specification.

Were this designed as a book of practice for the profession, it would be necessary to give particular directions for the proceedings in all these respects; but it being intended only to assist the inventor in his application for a patent, with the aid of some person already acquainted with the formal practice, the material points which demand his particular attention will alone be noticed; these are, the *caveat*, the *petition* and *affidavit* in support thereof, and the *specification*.

CHAPTER IV.

Of the Caveat.

THIS is merely a memorandum or notice left at certain offices, through which every patent must pass, describing the nature of the invention, and requesting that no patent for that purpose be allowed to pass without notice to the persons described in this memorandum or notice, and which is denominated a *caveat*.

The nature and effect of a caveat is very little understood, or rather much misunderstood. Many inventions have been pirated from the original inventors through their confident reliance on the supposed security which the caveat afforded. It has been very frequently supposed that a caveat would secure the sole right to an invention in the same manner, during the period for which it was entered, as though a patent had been obtained; that it would enable the party to practise the invention with security during the time in which he might be employed in bringing it to maturity or ascertaining its value; and that in consequence of having entered a caveat, no person could obtain a patent for the invention which the party claimed, nor even practise it; but that the party who had entered the caveat would secure the right to his patent whenever he should think proper to apply for it. In short, that it was to all intents and purposes a patent for a year (being the period for which it remains in force), and renewable from year to year.

This erroneous confidence in the power and effect of a caveat has been very frequently the cause of much injury to inventors; and it is truly astonishing how so erroneous an opinion should ever have been promulgated, though it is, perhaps, still more surprising that the prevalence of the opinion should be so very general as it has been found to be.

The author of this tract has indeed, in the course of his experience, found it to be an error almost universally prevalent; and it is much to be desired that inventors should be properly warned against the frauds to which they may be exposed by thus mistaking the true effect of a caveat.

A caveat, instead of being a security, is, on the contrary, but of little use; and in some instances it is advisable not to enter a caveat at all. When entered, it should be drawn up in very general terms, lest the invention should be pirated by some designing persons, to whom the caveat book may be submitted for inspection, which, for a trifling fee, may be examined by any one.

The fear of piracy in this way is by no means chimerical. The author has himself known several instances, in which advantage had actually been taken to pirate an invention, through the information to which the party was led by means of the caveat.

The universal prevalence of entering caveats has probably arisen from the direction given in the "*Book of Costs*," that upon applying for a patent in the first instance, the party must enter a caveat at the offices

of the Attorney and Solicitor Generals, and also at the office of the Great Seal. This is often improper advice, and frequently of no other use than to add unnecessarily to the expence of obtaining a patent.

The Attorney or Solicitor General, upon every application for a patent, is referred to, by the Secretary of State, for his advice whether it is fit that the patent should be granted; and a caveat is merely a doquet or request that these officers should give the party notice of any petition for a patent for any invention similar to the one intended to be protected. If, upon notice of an application for a patent for a similar invention, the party thinks it probable that it will interfere with the one for which he has entered a caveat, he gives notice of his intention to oppose the patent, and all parties are consequently summoned before the Attorney or Solicitor General, in order that each may explain privately, and in confidence to him, the merits of their respective claims. It sometimes happens, however, that the parties, although they live at a distance from each other, and evidently have never had any communication, the one with the other, may, notwithstanding, have accidentally hit on the same contrivance or invention. In that case it was formerly the practice to proceed to an examination to ascertain the actual priority of the invention; but it is now customary to recommend the parties to join their interests, by taking out a patent in conjunction, or otherwise to arrange matters so that they shall not become competitors. The reason given for this com-

premise proves the correctness of the preceding remarks to the full extent, as to the mistaken notion of the effect of a caveat. Each party being in possession of the other's secret, it is in the power of either, should the Attorney or Solicitor General award the patent to his opponent, to make the invention public before a patent can be completed, that is to say, before it can receive the Great Seal, in which case the patent would be invalid, and the invention become public property. Enough, perhaps, has been said to explain the nature of a caveat, and it will be requisite only to point out the cases where a caveat is of real utility.

It is desirable that a caveat should be entered when the party cannot readily determine on the prudence of obtaining a patent, either because it may not suit his pecuniary means, or because he must, for various reasons, communicate his secret to other persons; such, for instance, as workmen or others, whose assistance or advice he may require. In either of these instances a caveat may very properly be entered, as it will prevent all such persons from fraudulently and surreptitiously obtaining a patent for the invention which may have been communicated to them in confidence. But it must be recollected, that a caveat will not prevent these persons from publishing the invention, and thereby precluding the real inventor from obtaining a valid patent. For these reasons it is always desirable to apply for a patent with as little delay as prudence in other respects will permit; and, if it can possibly be avoided, not to make any person acquainted

with the nature of the invention previously to the patent having passed the Great Seal.

It is proper to enter a caveat on applying for a patent, to prevent other persons from running a race with the inventor to the Great Seal, and obtaining a patent before him for the same invention. This may be considered very probable, where the petition is for a patent for the importation from a foreign country.

The first application for a patent may, from various causes, be delayed, while another person may, in the mean while, receive the communication, and also apply for a patent. Under such circumstances, the present Chancellor, Lord Eldon, in the case, "ex parte Dyer," held, "that he could see no other mode of deciding than by awarding the patent to him that ran quickest."

When a patent has been obtained, it has been considered a good practice to continue caveats during the whole term of the patent, in order that no application may be made for any similar invention, without the knowledge of the first patentee, and that he may prevent the grant of a patent for an invention infringing on his own, which might happen from the ignorance of the parties. This practice of continuing a caveat by a patentee is to be recommended, as frequently preventing an infringement at little expence, and without endangering the original patent, which is liable to severe scrutiny in a court of justice, if an action be brought for an infringement on a patent. It can then only be sustained when it is perfect in all respects.

The late Lord Chief Justice, Lord Ellenborough, when Attorney General, stopped several patents, on the ground of interfering with other patents. It must, however, be a very obvious infringement to induce the Attorney or Solicitor General to take upon himself to decide in this way, as the parties have their remedy at law, and the benefit of a jury to decide, before whom competent witnesses can be examined. On the contrary, the time of the Attorney and Solicitor Generals is too much occupied by their various and important duties, to permit them examining witnesses at much length; and generally not being well versed in chemistry or mechanics, they are inclined to avoid giving a decision in a case of much nicety. It sometimes happens that the decision of the Attorney or Solicitor General is unsatisfactory to the parties, or that persons interested in, or claiming a right to, the invention, were not in time to oppose the patent in such stage of its progress. In that case it is usual to enter a caveat at the Great Seal; but this may be considered, even in point of expence, a bad practice, for the Chancellor has mostly decided that the patent, after having passed so far as the Great Seal, shall not be then stopped. This used to be the universal practice of the Court of Chancery; and Lord Eldon has, in addition, usually awarded that the costs of the application to the Court to remove the caveat be paid by the party entering the caveat, which formerly were invariably borne by each party, that is, each party paid his own costs. The effect of this practice was, that a

patent might be maliciously delayed for many weeks, and sometimes months, to the great and irreparable injury of the patentee, at the mere trifling expence of the caveat at the Great Seal. But by the present practice it is otherwise; for by fear of incurring the costs, a great deal of groundless litigation is avoided.

The following is the form of a caveat:—viz.

CAVEAT against granting a patent to any person or persons for [*Here insert the title or object of the invention intended to be protected.*] without notice to A. B. of &c. &c.

CHAPTER V.

Of the Affidavit and Petition.

The affidavit and petition are of more importance than is usually supposed, as all the proceedings for the patent are grounded on them. Great care, therefore, ought to be taken that the invention is accurately described in them. If the title given to the invention in the affidavit should not be correct, the patent itself will be faulty, and rendered voidable.

In preparing the affidavit, attention ought to be paid to the specification that is to follow as one of the conditions of the patent, and in which great care and nicety are required to make it complete, so as to ensure the validity of the patent.

The title given to the invention in the affidavit ought to be well considered, that it may correctly designate the invention for which the patent is desired; that it should be neither more nor less comprehensive than the facts warrant; that it should not describe the invention as a matter entirely new, when it is merely an improvement; that it should not be confined to one method when there are several methods to be stated; and so on the contrary.

If two modes have been invented for accomplishing one object, and are described in the specification, and the patent has been obtained for only one, under the title of a *method,* it will be a fatal defect in the patent; and so on the contrary; for the law apprehends fraud in such cases, and consequently inflicts a severe penalty. It is therefore necessary to be aware, in preparing the affidavit, that the title therein given to the invention will be exactly the same in the patent, with which the specification also must agree. This, though in fact a separate instrument, should therefore, in some respects, be considered as one and the same, or as a continuation or repetition of the same. A want of attention to this point is ordinarily the cause of so many patents being invalid. The insecurity of patents is by the inconsiderate too frequently imputed to a defect in the law, which, perhaps, with one exception only, could not be improved. Did they attend properly to the forms prescribed, and take out their patents properly, they would be in most cases safe.

Many patents now in force might be set aside from the incorrectness of their titles. The affidavit should not be too particular or minute in describing the invention, because in the passing of the patent through the offices, the title may be seen by some one who may learn from it the nature of the invention, and thereby take advantage of it, as observed in the case of the caveat.

The following is the form of the affidavit, which must be written on an affidavit stamp (value 2*s.* 6*d.*), and sworn before a Master, or, if in the country, a Master Extraordinary, in Chancery.

A. B. of ———, maketh oath and saith, that after much study and expense he hath invented (*Here insert the precise title of the invention*). That he is the first and true inventor thereof, and that the said invention is entirely new, and has never been practised or used by any other person or persons, to the best of his knowledge and belief.

Signed A. B.

SWORN at ——, this —— day of ——,
Before me, C. D.

The following is the form of the Petition.

To the King's Most Excellent Majesty.

The humble Petition of A. B. of

SHEWETH, That your Petitioner hath, after much study and expense, invented (*Here insert the title or object of the invention for which letters patent are required*), which invention he be-

lieves will be of great public utility. That he is the true and first inventor thereof, and that the said invention hath not been practised or used by any other person or persons whatsoever, to the best of his knowledge and belief.

Your Petitioner therefore humbly prays your Majesty will be graciously pleased to grant unto him, his executors, administrators, and assigns, your Majesty's Royal Letters Patent, under the Great Seal of your Majesty's United Kingdom of Great Britain and Ireland, for the sole use, benefit, and advantage of his said invention, within that part of your Majesty's United Kingdom of Great Britain and Ireland called England, your dominion of Wales, and town of Berwick-upon-Tweed, for the term of fourteen years, pursuant to the statute in that case made and provided.

And your petitioner will ever pray, &c.

When it is desired that the patent shall extend to the Colonies, the words "*and in all your Majesty's Colonies and Plantations abroad*" should be introduced after the word "*Tweed.*" A Patent for England does not extend to Scotland or Ireland, for each of which separate patents must be obtained.

CHAPTER VI.

Of the Specification.

WHEN patents were first granted it was not required of the patentee to enrol any description of the invention; but the Attorney and Solicitor Generals, who have the power of imposing any conditions on the patentee they may judge proper, considering that the practice which had arisen subsequently, of inserting a long account of the invention in the patent itself, was either very imperfect or very inconvenient, expensive, and also very unsafe for the inventor, as his invention might be pirated and made public before his patent had passed the Great Seal, directed that a full and particular description of the nature of the invention, and the manner in which it was to be performed, should be enrolled in Chancery within a certain period from the completion of the patent, otherwise the patent should be void. This period has been varied, according to the judgment of the Attorney and Solicitor General for the time being. It was at one time four months; then it was changed to one; and at present it is fixed, in ordinary cases, at two months; but longer time may be obtained, if necessary, upon a proper suggestion to the Attorney or Solicitor General, previously to his making the report in favour of the patent; and in the case of applying for a patent also for Scotland, four months

are granted; and when a patent for Ireland is likewise solicited, six months are allowed.

The greatest possible care and accuracy is requisite in preparing this instrument, and if it is in any respect defective it will vitiate the patent. This subject will come again under consideration in treating of the law of patents, from which a sufficient knowledge of what is requisite in the specification may, for all practical purposes, be obtained. Any other mode of explaining it might tend to mislead all parties; but the chief object of it is to describe the invention, that after the expiration of the patent any person of ordinary skill upon the subject may be enabled to prepare and use the invention.

CHAPTER VII.

Summary of the Law of Patents.

By the common law of England, which is principally the natural law of reason, all trade and manufacture is to be considered as perfectly free, and nothing can be more odious than the principle or practice of monopoly.

In times of feudal policy, when the soil and property of the whole nation were considered as held of an arbitrary Monarch, who could portion out what part he pleased among his favourites, it was, however, not unusual to grant monopolies by letters patent,

which have been subsequently restrained by the statute, 21 James I. c. 3.

It was the object of this statute to annul and destroy all monopolies whatsoever, the granting of which had then lately been carried to a very mischievous extent; but as it was considered a great encouragement to the improvement of trade and manufacture, that all who contribute to that desirable end should have an exclusive property in their new discoveries, or new manufactures, an exception was introduced into the statute, by a proviso, in favour of letters patent to be granted for the sole working or making of new manufactures, to be granted to the true inventors thereof for fourteen years.

It is, therefore, upon the effect of this proviso alone, that all the authority of any patent depends. Whatever is not within the words and obvious meaning of this exception in the statute, is not only invalid, but absolutely illegal, and any person aggrieved thereby is entitled to recover treble damages and cost, under section 4 of the same statute. In order to state the law clearly upon the subject, it will therefore be first necessary to set forth the principal clauses of the statute, and to add, by way of comment on the principal and operative words in it, such cases as have occurred, and such an exposition of its operation as is consistent with the train of the decisions upon the subject.

Statute of Monopolies.

21 James I, c. 3.

Intituled, **an Act concerning Monopolies and Dispensations, with Patent Laws, and Forfeitures thereof.**

I. *For as much* as your Most Excellent Majesty, in your royal judgment and of your blessed disposition to the weal and quiet of your subjects, did, in the year of our Lord God one thousand six hundred and ten, publish in print to the whole realm, and to all posterity, that all grants and monopolies, and of the benefit of any penal laws, or of power to dispense with the law, or to compound for the forfeiture, are contrary to your Majesty's laws, which your Majesty's declaration is truly consonant and agreeable to the ancient and fundamental laws of this realm: And whereas your Majesty was further graciously pleased expressly to command, that no suiter should presume to move your Majesty for matters of that nature; yet, nevertheless, upon misinformation and untrue pretences of public good, many such grants have been unduly obtained and unlawfully put in execution, to the great grievance and inconvenience of your Majesty's subjects, contrary to the laws of this your realm, and contrary to your Majesty's most royal and blessed intention, so published as aforesaid. For avoiding whereof and preventing the like in time to come, may it please your excellent Majesty, at the

humble suit of the Lords spiritual and temporal, and the Commons, in this present Parliament assembled, that it may be declared and enacted by this present Parliament, that all monopolies, and all commissions, grants, licences, charters, and *letters patent, heretofore made or granted to any person or persons, bodies politic or corporate, whatsoever, or for the sole buying, selling, making, working, or using of any thing within this realm,* or the dominion of Wales, or of any other monopolies, or of power, liberty, or faculty to dispense with any others, or to give licence or toleration to do, use, or exercise any thing against the tenor or purport of any law or statute, or to give or make any warrant for any such dispensation, licence, or toleration to be had or made; or to agree or compound with any others for any penalty or forfeitures limited by any statute; or of any grant or promise of the benefit, profit, or commodity of any forfeiture, penalty, or sum of money that is or shall be due by any statute, before judgment thereupon had; and whatsoever any way tending to the instituting, erecting, strengthening, farthering, or countenancing of the same, or any of them, are altogether contrary to the laws of this realm, and so are and shall *be utterly void and of none effect,* and in no wise to be put in use or execution.

II. And be it further declared and enacted, by the authority aforesaid, that all monopolies, and all such commissions, grants, licences, charters, letters patent, proclamations, inhibitions, restraints, warrants of as-

sistance, and all other matters and things tending as aforesaid, and the force and validity of them and of every of them, ought to be and shall be for ever hereafter examined, heard, tried, and determined, by and according to the common laws of this realm, and not otherwise.

III. And be it further enacted, by the authority aforesaid, that all person or persons, bodies politic and corporate, whatsoever, which now are or hereafter shall be, shall stand and be disabled and uncapable to have, use, exercise, or put in use, any monopoly, or any such commission, grant, licence, charter, letters patent, proclamation, inhibition, restraint, warrant of assistance, or other matter or thing tending as aforesaid, or any liberty, power, or faculty, grounded or pretended to be grounded on them, or any of them.

IV. And be it further enacted, by the authority aforesaid, that if any person or persons, at any time after the end of forty days next after the end of this present Session of Parliament, shall be hindered, grieved, disturbed, or disquieted, or his or their goods or chattels any way seized, attacked, distrained, taken, carried away, or detained, by occasion or pretext of any monopoly, or of any such commission, grant, licence, power, liberty, faculty, letters patent, proclamation, inhibition, restraint, warrant of assistance, or other matter or thing tending as aforesaid, and will sue to be relieved in or for any of the premises; that then, and in every such case, the same person or persons shall and may have his and their remedy for

the same at the common law, by any action or actions to be grounded upon this statute, the same action or actions to be heard and determined in the Courts of King's Bench, Common Pleas, and Exchequer, or in any of them, against him or them, by whom he or they shall be so hindered, grieved, disturbed, or disquieted, or against him or them by whom his or their goods or chattels shall be so seized, attacked, or distrained, taken, carried away, or detained, wherein all and every such person or persons which shall be so hindered, grieved, disturbed, or disquieted, or whose goods or chattels shall be so seized, attacked, distrained, taken, carried away, or detained, shall recover three times so much as the damages which he or they sustained by means or occasion of being so hindered, grieved, disturbed, or disquieted, or by means of having his or their goods or chattels seized, attacked, distrained, taken, carried away, or detained, and double costs; and in such suits, or for the staying or delaying thereof, no essoin, protection, wager of law, aid, prayer, privilege, injunction, or order of restraint, shall be in any wise prayed, granted, admitted, or allowed, nor any more than one imparlance. And if any person or persons shall, after notice given that the action depending is grounded upon this statute, cause or procure any action at the common law, grounded upon this statute, to be stayed or delayed before judgment, by colour or means of any order, warrant, power, or authority, save only of the Court wherein such actions as aforesaid shall be

brought and depending, or after judgment had upon such action shall cause or procure the execution of or upon any such judgment to be stayed or delayed, by colour or means of any such order, warrant, power, or authority, save only by writ of error or attaint; that then the said person or persons so offending shall incur and sustain the pains, penalties, and forfeitures, ordained and provided by the statute of provision and præmunire, made in the sixteenth year of the reign of King Richard the Second.

V. Provided nevertheless, and be it declared and enacted, that any declaration before-mentioned shall not extend to any letters patents, grants of privilege for the term of one-and-twenty years or under, heretofore made, of the sole working or making of any manner of new manufacture within this realm, to the first and true inventor or inventors of such manufactures, which others at the time of making such letters patent and grants did not use, so they be not contrary to the law nor mischievous to the state, by rising the prices of commodities at home, or hurt to trade, or generally inconvenient, but that the same shall be of such force as they were or should be if this act had not been made, and of none other; and if the same were made for more than one-and-twenty years, that then the same, for the term of one-and-twenty years only, to be accounted from the date of the first letters patent and grants thereof made, shall be of such force as they were or should have been if the same had been made but for the term of one-and-

twenty years only, and as if this act had never been made or had, and none other.

VI. Provided also, and be it declared and enacted, that any declaration before-mentioned shall not extend to any letters patents and grants of *privilege for the term of fourteen years or under, hereafter to be made, of the sole working or making of any manner of new manufactures, which others, at the time of making such letters patent and grants, shall not use, so as also they be not contrary to the law, nor mischievous to the state, by raising of prices of commodities at home, or hurt of trade, or generally inconvenient;* the said fourteen years to be accounted from the date of the first letters patents, or grants of such privilege hereafter to be made, but that the same shall be of such force as they should be if this act had never been made, and of none other.

VII. Provided also, and it is hereby further intended, declared, and enacted, by authority aforesaid, that this act, or any thing therein contained, shall not in any wise extend or be prejudicial to any grant or privilege, power or authority, whatsoever, heretofore made, granted, allowed, and confirmed, by any Act of Parliament now in force, so long as the same shall continue in force.

VIII. Provided also, that this act shall not extend to any warrant or privy seal, made or directed, or to be made or directed by his Majesty, his heirs, or successors, to the Justices of the Courts of the King's Bench or Common Pleas, and Barons of the Exche-

quer, Justices of Assize, Justices of Oyer and Terminer and Gaol-delivery, Justices of the Peace, and other Justices for the time being, having power to hear and determine offences done against any penal statute depending in suit and question before them, or any of them respectively, after plea pleaded by the party defendant.

IX. Provided also, and it is hereby further intended, declared, and enacted, that this act, or any thing therein contained, shall not in any wise extend or be prejudicial unto the city of London, or to any city, borough, or town corporate within this realm, for or concerning any grants, charters, or letters patents, to them or any of them; or unto any corporations, companies, or fellowships of any art, trade, occupation, or mystery, or to any companies or societies of merchants within this realm, erected for the maintenance, enlargement, or ordering of any trade of merchandize; but that the same charters, customs, corporations, companies, fellowships and societies, and their liberties, privileges, powers, and immunities, shall be and continue of such force and effect as they were before the making of this act, and of none other; any thing before in this act contained to the contrary in any wise, notwithstanding.

X. Provided also, and be it enacted, that this act, or any declaration, provision, disablement, penalty, forfeiture, or other thing before-mentioned, shall not extend to any letters patents of grants of privilege heretofore made or hereafter to be made of, for, or

concerning the digging, making, or compounding of saltpetre, or gunpowder, or the casting or making of ordnance, or shot for ordnance, nor to any grant or letters patents heretofore made, or hereafter to be made, of any office or offices heretofore erected, made, or ordained, now in being, and put in execution, other than such offices as have been decried by any His Majesty's proclamation or proclamations; but that all and every the same grants, commissions, and letters patents, and all other matters and things tending to the maintaining, strengthening, and furtherance of the same, or any of them, shall be and remain of the like force and effect, and no other, and as free from the declarations, provisions, penalties, and forfeitures contained in this act, as if this act had never been had nor made, and not otherwise.

XI. Provided also, and be it enacted, that this act, or any declaration, provision, disablement, penalty, forfeiture, or other thing before-mentioned, shall not extend to any commission, grant, letters patents, or privilege heretofore made, or hereafter to be made, of, for, or concerning the digging, compounding, or making of alum, or alum-mines; but that all and every the same commissions, grants, letters patents, and privileges, shall be and remain of the like force and effect, and no other, and as free from the declarations, provisions, penalties, and forfeitures contained in this act, as if the act had never been had nor made, and not otherwise.

XII. Provided also, and be it enacted, that this

act, or any declaration, provision, penalty, forfeiture, or other thing before-mentioned, shall not extend or be prejudicial to any use, custom, prescription, franchise, freedom, jurisdiction, immunity, liberty, or privilege heretofore claimed, used, or enjoyed by the governors and stewards and brethren of the fellowship of the hoast-men of the town of Newcastle-upon-Tyne, or by the ancient fellowship, gild, or fraternity, commonly called hoast-men, for or concerning the selling, carrying, lading, disposing, shipping, venting, or trading of or for any sea coals, stone coals, or pit coals, forth or out of the haven or river of Tyne, or to any grant made by the said governor and stewards and brethren of the fellowship of the said hoast-men to the late Queen Elizabeth, of any duty or sum of money to be paid for, or in respect of any such coals as aforesaid; nor to any grants, letters patents, or commission, heretofore granted, or hereafter to be granted, of, for, or concerning the licensing of the keeping of any tavern or taverns; or selling, uttering, or retailing of wines to be drunk or spent in the mansion-house, or houses, or other place in the tenure or occupation of the party or parties so selling or uttering the same; or for or concerning the making of any compositions for such licences, so as the benefit of such compositions be reserved and applied to and for the use of his Majesty, his heirs, or successors, and not to the private use of any person or persons.

XIII. Provided also, and be it enacted, that this act, or any declaration, provision, penalty, forfeiture,

or other thing before-mentioned, shall not exend or be prejudicial to a grant or privilege for or concerning the making of glass, by his Majesty's letters patents under the great seal of England, bearing date the two-and-twentieth day of May, in the one-and-twentieth year of his Majesty's reign of England, made and granted to Sir Robert Mansel, Knight, Vice Admiral of England: nor to a grant or letters patents, bearing date the twelfth of June, in the thirteenth year of his Majesty's reign of England, made to James Maxewell, Esquire, concerning the transportation of calves skins: but that the said several letters patents, last mentioned, shall be and remain of the like force and effect, and as free from the declarations, provisions, penalties, and forfeitures before-mentioned, as if this act had never been had nor made, and not otherwise.

XIV. Provided also, and be it declared and enacted, that this act, or any declaration, provision, penalty, forfeiture, or other thing before-mentioned, shall not extend or be prejudicial to a grant or privilege for or concerning the making of smalt, by his Majesty's letters patents, under the great seal of England, bearing date the sixteenth day of February, in the sixteenth year of his Majesty's reign of England, made or granted to Abraham Baker; nor to a grant or privilege for or concerning the melting of iron ewer, and of making the same into cast-works or bars with sea coals or pit coals, by his Majesty's letters patents, under the great seal of England, bearing

date the twentieth day of February, in the nineteenth year of his Majesty's reign of England, made or granted to Edward, Lord Dudley; but that the same several letters patents and grants shall be and remain of the like force and effect, and as free from the declarations, provisions, penalties, and forfeitures before-mentioned, as if this act had never been had nor made, and not otherwise.

The patent contains certain terms and restrictions which it has been found beneficial for the public to introduce; and as these must also be considered in ascertaining the effect and validity of a patent, we shall next insert the usual form now adopted. It is material that every patentee should carefully peruse and consider the claims and conditions of the patent, in order that he may clearly understand the terms upon which the grant has been made.

The form of Letters Patent for Inventions.

GEORGE, R.

George the Fourth, by the Grace of God, &c.— To all to whom these presents shall come greeting. Whereas A. B. of   in the county of   hath by his petition humbly represented unto us that he hath, after much study and expence, invented *certain improvements in steam-engines,* which the petitioner conceives will be of great

public utility; that he is *the first and true inventor thereof*, and that the same has not been practised or used by any other person or persons, to the best of his knowledge and belief. The petitioner therefore most humbly prayed that we would be graciously pleased to grant unto him, his executors, administrators and assigns, our royal letters patent, under the great seal of our united kingdom of Great Britain and Ireland, for the sole use, benefit, and advantage of his said invention, within that part of our united kingdom of Great Britain and Ireland, called England, our dominion of Wales, and town of Berwick-upon-Tweed, and also within all our Colonies and Plantations abroad,* for the term of fourteen years, pursuant to the statute in that case made and provided; and we being willing to give encouragement to all arts and inventions which may be for the public good, are graciously pleased to condescend to the petitioner's request, *Know ye therefore, that we, of our especial grace, certain knowledge and mere motion, have given and granted, and by these presents for us, our heirs, and successors, Do give and grant unto the said A. B.* his executors, administrators and assigns, our especial licence, full power, sole privilege and authority, that he the said A. B. his executors, administrators and assigns, and every of them by himself and themselves, or by his or their deputy or deputies, servants or agents, or

* Three distinct patents must be obtained for the three several united kingdoms of England, Scotland, and Ireland; but the Colonies may be mentioned and comprised in the English patent.

such others as he the said A. B. his executors, administrators and assigns, shall at any time agree with, and no others, from time to time, and at all times hereafter, during the term of years herein expressed, shall and lawfully may make use of, exercise, and vend his said invention within that part of our united kingdom of Great Britain and Ireland, called England, our dominion of Wales, and town of Berwick-upon-Tweed, in such manner as to him the said A. B. his executors, administrators and assigns, or any of them, shall in his or their discretions seem meet. And that he the said A. B. his executors, administrators and assigns, shall and lawfully may have and enjoy the whole profit, benefit, commodity and advantage from time to time coming, growing, accruing and arising by reason of the said invention, for and during the term of years herein mentioned, to have, hold, exercise, and enjoy the said licence, powers, privileges, and advantages hereinbefore granted or mentioned to be granted unto the said A. B. his executors, administrators and assigns, for and during, and unto the full end and *term of fourteen years, from the* DATE *of these presents next and immediately ensuing, and fully to be complete and ended according to the statute in such case made and provided.* And to the end that he the said A. B. his executors, administrators and assigns, and every of them, may have and enjoy the full benefit and the sole use and exercise of the said invention, according to our gracious intention hereinbefore declared. We do by these

presents, for us and our heirs and successors, require and strictly command all and every person and persons, bodies politic and corporate, and all other our subjects whatsoever, of what estate, quality, degree, name, or condition soever they be, within that said part of our united kingdom of Great Britain and Ireland, called England, our dominion of Wales, and town of Berwick-upon-Tweed aforesaid, that neither they, nor any of them, at any time during the continuance of the said term of fourteen years hereby granted, either directly or indirectly, do make use or put in practice the said invention, or any part of the same so attained unto by the said A. B. as aforesaid, nor in any wise counterfeit, imitate, or resemble the same, nor shall make, or cause to be made, any addition thereunto, or subtraction from the same, whereby to pretend himself or themselves the inventor or inventors, devisor or devisors thereof, without the licence, consent, or agreement of the said A. B. his executors, administrators and assigns, in writing, under his or their hands and seals, first had and obtained in that behalf, upon such pains and penalties as can or may be justly inflicted on such offenders for their contempt of this our royal command; and further, to be answerable to the said A. B. his executors, administrators and assigns, according to law, for his and their damages thereby occasioned. And moreover, We do by these presents, for us, our heirs and successors, will and command all and singular the justices of the peace, mayors, sheriffs, bailiffs, constables, head boroughs, and all other officers and

ministers whatsoever of us, our heirs and successors for the time being, that they or any of them do not, nor shall at any time hereafter during the said term hereby granted, in any wise molest, trouble, or hinder the said A. B. his executors, administrators and assigns, or any of them, or his or their deputies, servants or agents, in or about the due and lawful use or exercise of the aforesaid invention, or any thing relating thereto; provided always, and these our letters patent are and shall be upon this condition, that if at any time during the said term hereby granted, it shall be made appear to us, our heirs or successors, or any six or more of our or their privy council, that this our grant is contrary to law, or prejudicial, or inconvenient to our subjects in general, or that the said invention is not a new invention, as to the public use and exercise thereof in that said part of our united kingdom of Great Britain and Ireland, called England, our dominion of Wales, and town of Berwick-upon-Tweed aforesaid, *or not invented and found out by the said A. B. aforesaid, then upon signification or declaration thereof, to be made by us, our heirs and successors, under our or their signet or privy seal, and by the lords of our or their privy council, or any six or more of them under their hands, these our letters patent shall forthwith cease, determine, and be utterly void, to all intents and purposes, any thing hereinbefore contained to the contrary thereof, in any wise notwithstanding.* Provided also, that these our letters patent, or any thing herein contained,

shall not extend, or be construed to extend, to give privilege unto the said A. B. his executors, administrators or assigns, or any of them, to use or imitate any invention or work whatsoever, which *has heretofore been found out or invented by any* other of our subjects whatsoever, and publicly used or exercised in that said part of our united kingdom of Great Britain and Ireland, called England, our dominion of Wales, or town of Berwick-upon-Tweed, unto whom like letters patent or privileges have been already granted for the sole use, benefit, and exercise thereof; it being our will and pleasure that the said A. B. his executors, administrators and assigns, and all and every other person or persons to whom like letters patent or privileges have been already granted as aforesaid, shall distinctly use, practise their several inventions by them invented and found out, according to the true intent and meaning of the respective letters patent and of these presents. Provided likewise, nevertheless, and these our letters patent are upon this express condition, that if the said A. B. his executors, administrators and assigns, or any person or persons which shall or may at any time hereafter during the continuance of this grant, have or claim any right, title or interest, in law or equity, of, in or to the power, privilege and authority, of the use and benefit of the said invention hereby granted, shall make any transfer or assignment, or any pretended transfer or assignment, of the said liberty and privilege, or any share or shares of the benefit or profit thereof, or shall declare any

trust thereof to or for any number of persons exceeding the number of five, or shall open, or cause to be opened, any book or books for public subscriptions, to be made by any number of persons exceeding the number of five, in order to the raising any sum or sums of money under the pretence of carrying on the said liberty or privilege hereby granted, or shall by him or themselves, or his or their agents or servants, receive any sum of money whatsoever of any number of persons exceeding in the whole the number of five, for such or the like intents or purposes, or shall presume to act as a corporate body, or shall divide the benefit of these our letters patent, or the liberty and privileges hereby granted, into any number of shares exceeding the number of five, or shall commit, or do, or procure to be committed or done, any act, matter or thing whatsoever, during such time as such person or persons shall have any right or title, either in law or equity, in or to the said premises, which will be contrary to the true intent and meaning of a certain Act of Parliament, made in the sixth year of the reign of our late royal great grandfather, King George I. intituled, "An Act for the better securing certain powers and privileges intended to be granted by his Majesty by two charters for assurance of ships and merchandizes at sea, and for lending money upon bottomry, and for restraining several extravagant and unwarrantable practices therein mentioned." Or in case the said power, privilege, and authority shall at any time hereafter become vested in or in trust for more than the

number of five persons, representatives at any one time, reckoning executors and administrators as and for the single person whom they represent, as to such interest as they are or shall be entitled in right of such their testator or intestators; that then and in any of the said cases, these our letters patent, and all liberties and advantages whatsoever hereby granted, shall utterly cease, determine, and become void, any thing hereinbefore contained to the contrary thereof in any wise notwithstanding. Provided also, that if the said A. B. shall not particularly describe and ascertain the nature of his said invention, and in what manner the same is to be performed, by an instrument in writing under his hand and seal, and cause the same to be enrolled in our High Court of Chancery, within two calendar months next and immediately after the date of our said letters patent, that then these our letters patent, and all liberties and advantages whatsoever hereby granted, shall utterly cease, determine, and become void, any thing hereinbefore contained to the contrary thereof in any wise notwithstanding. And lastly, we do by these presents, for us, our heirs and successors, grant unto the said A. B. his executors, administrators and assigns, that these our letters patent, or the enrolment or exemplification thereof, shall be in and by all things good, firm, valid, sufficient and effectual in the law, according to the true intent and meaning thereof, and shall be taken, contrived, and adjudged in the most favourable and beneficial sense for the best advantage of the said A. B. his

executors, administrators and assigns, as well in all our courts of record as elsewhere; and by all and singular the officers and ministers whatsoever of us, our heirs and successors, in that part of our united kingdom of Great Britain and Ireland, called England, our dominion of Wales, and town of Berwick-upon-Tweed aforesaid, and amongst all and every the subjects of us, our heirs and successors, whatsoever and wheresoever, notwithstanding the not full and certain describing the nature and quality of the said invention, or of the materials thereto conducing and belonging.

Witness ourself at Westminster, this day of in the year of our reign.

From a review of the statute 21 James I. c. 3, and of the form of the patent, it will appear, in the first place, that a patent cannot be granted for more than *fourteen years;* that it must be for the *sole working* or *making* of any manner of *new manufacture* within these realms, to the *true* and *first inventor*, which *others* at *the time* of making such letters patent shall not *use*, so as also they be not contrary to the law, nor mischievous to the state, by raising prices of commodities at home, or hurt of trade, or generally inconvenient.

And that, secondly, according to the form of the patent, if at any time during the term it shall be

made appear to the King or his Council that the grant is contrary to law, or prejudicial or inconvenient to the King's subjects in general, or that the invention is not a *new* invention, as to the *public use* and exercise thereof in this realm, or not invented and found out by the patentee, the patent shall be void. Also that it shall give no licence to *use* or *imitate* any invention or work whatsoever which has heretofore been found out or invented and *publicly used* in this realm, and for which a patent has been granted. Also that if the patent be transferred to or *in trust for* more than five persons, or to any who act as a corporate body, or in contravention of the act 1 Geo. I. for securing the privileges granted by charter to the Royal Assurance Company, &c. And lastly, if the patentee shall not, within a given time, *particularly describe* and ascertain the *nature* of his *invention*, and in what *manner* it is to be *performed*, by an instrument in writing under his hand and seal, to be enrolled in Chancery, the patent will be utterly void.

In the conclusion, the patent contains a grant that it shall be construed most beneficially for the patentee, which is not the case with ordinary grants from the crown.

By particularly attending to the passages in italics, we shall have a clear view of the most useful part of the law concerning patents, arranged in an order entirely practical.

As to the time or duration of patents, they are limited to fourteen years; but by Act of Parliament,

in particular cases, and under special circumstances, they have been continued for a longer period, as in the case of *Boulton* and *Watts'* steam-engine, and several other instances.

From the words in the statute, sole working or making of any manner of new manufacture, it is plain that the object of the act was to encourage domestic trade and manufactures in general, and not mere scientific discoveries.

The word *sole* conveys to the patentee what is ordinarily called the monopoly, but which is more properly the exclusive right of manufacture; for as is observed in the case of *Boulton* and *Watt*, it is the *working* or *making* of the manufacture which is protected, and not the *sole buying* and *selling* a manufacture, which could hardly be brought within the qualification, that the patent shall not be contrary to law, or prejudicial to trade. Were it extended to the sale of the invention, none but the patentee could vend his own invention, and the manufacture could be sold but once; but by restricting the *working* or *making* of the article, all interference with the interest of the inventor is sufficiently prohibited.

Notwithstanding, however, these obvious considerations, *foreign articles* are considered as new manufactures upon their *first introduction here*, although they may have been sold abroad;* and patents are consequently frequently granted for inventions

* Edgebury v. Stephens, Salkeld's Reports, ii. p. 227.

which are made known from the communications of foreigners, it being indifferent in law whether a man be learned by travel or by study, the object being to encourage improvements in arts and manufactures.

The terms new manufacture come next to be considered, and the construction of these words seems to have occasioned all the difficulties that have occurred.

By the term *new* is not to be understood that every thing in the manufacture shall be novel and strange, which is impossible, but that essentially it shall be different in some main and *principal* point, from all other manufactures of the same kind, hitherto used in these realms.

Hence it has been held, that a patent for an improved manufacture is good.*

But as it is obvious that the improvement is the essential novelty, a patentee, by adding an improvement to an old manufacture, cannot entitle himself to an exclusive right in the whole manufacture: but the public must have the same right of using the old manufacture as before.

The patent must therefore be confined to the improvement; and when a patent was taken out for a watch, and the invention was merely an improvement, by the invention of a particular movement, such as an escapement, it was held void.†

Upon this point, as well as others, the leading case

* Per Lord Mansfield in Morris v. Branston, Bull. Ni. Pri. 77.

† See Jessop's case, cited in Boulton and another v. Bull, 2 H. Blacks. p. 463.

of *Boulton* v. *Bull* appears to have turned. Mr. Watt had improved the steam-engine, by inventing a new method of condensing the steam, which saved steam and fuel. This consisted in condensing the steam out of the cylinder, and keeping the cylinder hot. The mechanical form of the cylinder, or of the condenser, might be varied in many ways; but whenever these were separate, the essential properties of Mr. Watt's invention were imitated.

The Court, upon further investigation, considered that the terms of the patent claimed no other right than this, of making all condensers and cylinders, in which the steam should be condensed out of the cylinder, and held the patent good.

It is upon this principle that the case could alone be supported, and when thus explained, it appears plain and simple; but such is the confusion of language, that entirely for want of a good technical description, this patent was litigated with great force, and supported at least with great difficulty.

Manufacture is the next important word in the statute, and is supposed to be applied to *principle* or to *method*, for which latter it has been argued a patent cannot be granted.

Yet in the case of *Boulton* v. *Bull* the patentee had described his invention as a new principle, and had claimed his right for the particular principle, and there are daily instances of patents taken out for a method.

We shall endeavour to reconcile these apparent

inconsistencies, which, like many others, arise from verbal disputes.

The word manufacture has two senses. It means a thing made with hands, and in some cases the making of a thing with hands. In either of these senses, when the thing made is a vendible substance, essentially new in some particulars, it may be the subject of a patent either for the whole substance produced, or for the particular novelty in it, as the case may be, and as the one is separable from the other.

Manufacture, in this sense, is as universal as artificial substance; as the things which hand can produce; as the mechanical arts; and as practical chemistry. It is to artificial productions and mechanical substances, or vendible commodities of man's own invention, modification, and contrivance, to which the patent right applies.

It excludes all natural productions, all engrossing of newly imported minerals, seeds, or animals, or their raw products, and it is opposed, as it should seem, to all mere manipulations or acquirements of manual dexterity, as well as to all scientific principles.

These consist in mere *methods*, or in *ideas* and notions, which are incapable of being restrained by any patent.

It has, however, frequently happened, that the patentees have described their inventions as *methods* and *principles*, where they have been, in reality, actual new *manufactures*, or new *processes*, in manufacture.

In these cases there is no peculiar effect to be attached to the particular words, but the Court has so construed them as to consider the whole of the patent together, and thence decided whether the patent was in effect for a new manufacture or not, and this we shall exemplify when we come to treat of the specification.

"*Within these realms.*" It is by the effect of this clause that, as we have seen before, a foreign invention may become the subject of a patent upon its first importation into Great Britain.

"*To the true and first inventor.*" Hence, it appears, that the patent can only be granted to the inventor, and not to his assignee. But who is the first and true inventor is a question sometimes of difficulty.

In the case of *Dollond's* patent one *Hall* had originally made the discovery of the principle upon which the acromatic telescopes were afterwards constructed; but he, says Lord Chief Justice *Eyre*, in the case of *Boulton* v. *Bull*, made the discovery in his own closet, but never made it public: and on that ground *Dollond's* patent was sustained.

It should seem, however, that if *Dollond* had not himself also discovered it, he could not have been entitled to the patent.

But when one *Tennant* had, in 1798, obtained a patent for an improved bleaching liquor, a chemist at *Glasgow* deposed, that having had frequent communications with him, he had suggested that *Tennant*

would obtain his object by keeping the lime water constantly agitated; and *Tennant* afterwards, in 1796, two years before the patent, told him this *method* or process had succeeded. A bleacher at *Nottingham* also deposed that he had used it five or six years before the patent, though he kept his process a secret from all but his partners and two men concerned in preparing the liquor.

Upon these grounds the *plaintiff* was nonsuited, in an action brought for the infringement of the patent, and tried December 22, 1802, before Lord Ellenborough, Chief Justice, and a special jury.

"*Which others at the time of making such letters patent shall not use.*"

This clause is a farther explanation of the meaning of the words *new manufacture*, namely, it must be something which is not in use, or has not been made in this realm by others, at the time of granting the patent. And this must clearly be understood of a *bonâ fide* use, for if, while in the attempt to construct the machinery, some workman should surreptitiously pirate it, the original inventor would still be entitled to the patent by force of the previous words "*the true and first inventor,*" and such a fraudulent use could not be a bar to his claim. Even if a patent were granted by surprise to the other party, it should seem that it might be revoked on a *scire facias*, and a new one granted to the true inventor. But it is presumed that a patent obtained under either of these circumstances would be of very doubtful validity.

"*And also that they be not contrary to the law, nor mischievous to the state, by raising prices of commodities at home, or hurt of trade, or generally inconvenient.*"

This clause is the least definite in its meaning and application of the whole act.

In the case of the King v. Arkwright,* an issue was taken upon the *scire facias,* "that the patent was inconvenient to the king's subjects in general." But upon this issue the learned judge said, that it was merely consequential, and he could not receive any evidence upon it. It stated no fact which a jury would try, nor which the defendant could come prepared to answer.

Patents under the act 21 James I. cannot properly raise the price of commodities, because they are in effect for new commodities, of which there can have been no current price previously. But, as was before remarked, if a patent should be obtained for a foreign invention, and the patentee charged more than it can be imported for from abroad in its perfect state, it would seem that such a case would fall within this clause, and the patent be inconvenient to the public, and tend to raise the price of commodities. Such a case, however, is not likely to occur, and the whole may be considered rather as a saving clause of extreme caution and little practical effect.

With regard to the patent itself, many of the clauses and operative words which we have marked,

* Bull. Ni. Pri. 77.

are mere repetitions of the restrictions imposed by the statute, and contain a reservation of the right or power of the crown to recal the patent, in case it shall have been imposed upon; all which has been already sufficiently discussed.

It next contains a proviso, making the patent void upon its being transferred to, or in trust for, more than five persons, or in contravention of the act which establishes the Royal Exchange and Royal Assurance Companies.

The precise policy of this clause is by no means apparent, as to the assigning it in trust for more than five persons.

For if it is an invention of a manufacture so costly that it cannot be carried on without the joint capital of more than five persons, to restrain it to less is hardly beneficial to the community, since it is to forbid its use. Whereas if one alone may exercise it, there seems little difference to the community, whether the profit is shared between few or many; and parliament have removed this difficulty, when required, as in the case of the straw paper manufacture, for which an act was passed enabling sixty persons to be concerned.

The most important clause in the patent is that which requires the specification to be filed or enrolled within two months or such other time as shall be specified by the patent.

"This instrument must particularly describe and ascertain the nature of the invention, and in what manner it is to be performed."

If this description be false it is clearly void.* Even if it is unnecessarily ambiguous, so as to mislead the public, who are entitled to know the correct process, it is said to be bad.† As where in a process for making yellow paint, *any* fossil salt was directed to be used, when only *sal gem* would produce the effect, the patent was held void. So where in tempering steel trusses the patentee had omitted to state the rubbing of them with tallow, which was a necessary process, the patent was held void.—*Liardet* v. *Johnson*.

So if the process stated in the specification does not produce the substance for which the patent is obtained, it is void. As where the patent was for producing a yellow colour and making white lead by one process, and white lead could not be produced by it, the specification was held to be bad, and the patent void.

The object of the specification is to enable the public to have the benefit of the general use of the manufacture after the expiration of the patent right; and therefore the machine, manufacture, or process, should be so clearly described as to enable any person of ordinary capacity in the trade or manufacture of which the invention is an improvement to make or produce it; but it need not contain mere incidents known to every common manufacturer; in the same way as, if any article were mixed with gold in a state of fusion, it need not set forth how gold is to be fused or melted; and where it is for an addition or

* Bull. Ni. Pri. p. 77.

† Per Ashurst, J. 1 T. Rep. p. 602.

improvement, it will be only necessary to state the particulars of the addition or improvement, and how they are to be attached to the old machine.

Drawings of machinery are not absolutely requisite, but must necessarily be added where it is difficult to understand the mechanism without them. Many persons of judgment and experience, among whom may be named the late Mr. Nicholson, whose assistance in preparing specifications was much sought, have strongly recommended their omission where a sufficient description could be given without them, on the principle that in the event of a reference to a jury, upon any question of an infringement, they were apt to confine their view of the invention to the precise drawings in the specification, although the infringement complained of might be the same, only varying the form of the machinery.

In the case of *Boulton* v. *Bull*, the specification of Mr. Watt's *Engine* was without a drawing, and it was held that the specification was complete without.

The time of enrolling the specification must be strictly observed, as, after the patent is once granted, no extension of the period can be obtained.

There are two remedies by which the patentee may protect his right.

He may at common law bring an action upon the case for damages, or he may file a bill in equity against the party for an injunction to restrain him from using the manufacture, and for an account of the quantities which he has made and sold, and that the party shall pay over the profits.

In the first place the plaintiff must give evidence in support of his specification to show that he has actually produced the manufacture, machinery, substance, or improvement, which is the subject of his patent. He must then prove the infringement of it on the part of the defendant; and should the contrary party be unable to show that the invention was not new at the time the patent was granted, nor that the patentee had violated, or not complied with, any of the provisoes of the grant, he will be entitled to a verdict for such damages as he can prove he has sustained.*

The remedy in equity is stated to be preferable to an action at common law, because the party may, in the first instance, be restrained from further using the manufacture, and must by his answer confess the extent of the injury.

When different persons, not partners in trade, have in different instances infringed a patent, the party must file separate bills against each, and cannot join the cases in one bill.†

Where a patent is improperly obtained, the usual way to set it aside is by applying to the Court of Chancery for a *scire facias* at the suit of the crown, which will issue on the authority of the *attorney-general* upon the application of any private party.

* Bull. Ni. Pri. p. 77.

† Per Ashurst, J. 17 Rep. p. 602.

INDEX.

C. Baldwin, Printer,
New Bridge Street, London.